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Graphic Analyses of Estimates

IN estimating the cost of power-plant betterments, it is an excellent plan where time permits to prepare a number of cost tabulations showing the anticipated outlays for the various schemes which might be applied to the local problem. The benefits of working out more than one solution for an engineering problem are many. Unlike the "sums" of our school days, it very often happens in engineering that there is no positive solution of the question at issue which stands out above all others as the correct answer, professional experience and judgment being required, in fact, to identify the better procedure after the figures are all in.

A careful estimate made not long since of the cost of building a steam turbine station is of interest in the above connection. It was found that if a 6,250-kilowatt unit should be provided, the plant would cost about $308,000; while if a 4,000-kilowatt outfit should be installed, the cost would reach but $243,350, including in both cases engineering and contingencies. Thus it became apparent that by an increase of roughly 25 per cent in investment, the plant capacity could be raised by over 50 per cent, and after taking the existing and prospective loads into consideration, with the available outputs of the hydroelectric stations into which the new steam plant was to be tied, the directors voted in favor of the larger plant. Now the above solutions of the particular plant problem in hand gave of course only two points on a curve of estimated cost balanced against plant capacity. In the case furnishing the figures, it is possible that two "workouts" of the problem, each going into detailed station items, sufficed; but certainly plenty of instances arise in general practice where if several sets of costs are computed and then plotted, great advantage results.

Thus, it may work out that an intermediate solution may appear from the resultant cost curve best suited to the conditions in hand, especially if several curves are plotted for various combinations of station units. The larger the station, the more solutions it will pay to work out, of course, and sometimes a goodly number of these may be required even where standard sizes of generating units seem few in relation to their suitable combination for the local requirements. It has been well said that plants can be built very much more cheaply on paper than in concrete, copper and steel, and it is difficult tc exaggerate the advantages of thorough preliminary studies. When these are reduced to graphic form, it often happens that what might be called parallel solutions appear on the plots, giving the engineer making the computations and whoever analyzes the diagrams a quicker insight into the practicable ranges of equipment combination fitting into the prescribed cost limitations than usually appears from tabular exhibits of data, or from written statements of the results of the estimate calculations.

Revision of the National Electrical Code

ONE of the strongest features of the National Electrical Code is the fact that it was conceived in a liberal spirit. It never was professed in its original or subsequent forms that it was a rigid and infallible guide to satisfactory electrical construction. An outgrowth of the need for regulations to minimize the early fire hazards resulting from the use of electricity, it was seen that as electrical construction materials and methods were developed many changes in the Code would be necessary to keep pace with these developments. From this has grown the admirable custom of revising the Code every two years.

Such a biennial revision is to be made this year; in fact, the principal meeting for consideration of proposed changes in the Code is to be held in New York City this month, as was announced in the last issue, in which the principal changes proposed were summarized. The Electrical Committee in general charge of the revision, and its numerous subcommittees, have been very active in their consideration of various suggested changes and their carefully worked out recommendations will doubtless be followed quite closely in the final revision. Although there is still much difference of opinion respecting many proposed amendments, which therefore have not yet reached the state of recommendations, the number of the latter is unusually large and in many respects very important.

Mention need be made particularly of but one important group of recommendations, which is that of the Subcommittee on Grounding. This subject has been given thorough study, as the result of which we have proposed an almost complete redrafting of the requirements respecting grounding, which is given at length in this issue. Specially noteworthy in this connection is the general tendency to include in the National Electrical Code features making for a diminution of life and accident hazards. For instance, the proposed use of an identified wire for neutral and other grounded conductors, while seemingly a radical move, is really a long step in advance to insure grounding in a dependable manner. Grounding of fixture and appliance casings would not be opposed to any extent,

if the liability to reversal of the wires were eliminated. The proposal to work toward such required grounding of casings and covers should be encouraged, as it will tend to reduce materially what now seems an increasing hazard. It is, therefore, gratifying to find the Code being steadily broadened to cover life as well as fire hazards.

A Complimentary Incentive

A RECENT issue of a gas contemporary deals with getting business in a way that is worthy of attention and deserving of our appreciation for the unintended compliment implied. In plain outspoken and serious vein it pleads that the gas interests follow the example of their rival, the electrical industry, in inaugurating a prominently vigorous nation-wide publicity campaign. At some length it points out that whilst the gas and electric utilities are spending about the same proportion of their revenue annually in developing new business, namely 3.8 and 3.2 per cent respectively, the electrical manufacturers, jobbers and retailers are augmenting the expenditure of the electrical utilities enormously by co-operative advertising and publicity work. It further points out that it is only by the support of the electric-appliance manufacturers, dealers and associations that the Society for Electrical Development is possible. Since, however, only about one-fifth of the money spent for electrical material and service goes to the central-station companies, money spent by others than the central stations in advertising and furthering the interests of the electrical industry, and central-station service in particular, is really money spent in their own cause.

This journal asks the manufacturers and dealers in the gas business to co-operate and support, practically as well as morally, the gas utilities in working toward increased business. It suggests the best way to do this is to support a national publicity office, establish small stores in every town, and keep them well stocked, and place the advantages of gas before the public in the same fascinating and prominent fashion that do the electrical interests. If the gas interests would do these things the gas industry would break even with the electrical industry in obtaining new business, increasing expansion and in greater gross earnings, it is claimed.

That the gas industry should strive for increased publicity at this date is undoubtedly due to one cause, and possibly several causes. Certainly the gas industry realizes the benefits that accrue from wise judicious co-operative nation-wide advertising upon an enormous scale: the gross earnings of the central stations increased 15 per cent last year over the previous year. It is possible the gas interests are beginning to feel the pinch of competition, if not in the actual demands for gas in applications previously considered unassailable. It may even be that they already feel the encroachment of electricity upon their domain, and fear eventual and serious curtailments if not actual extermination. Be this as it may, the gas interests are beseeched to copy the advertising methods instituted by the electrical interests.

Imitation is the height of flattery, and it is indeed flattering to know that the gas industry likes our methods of getting new business and developing our industry. In unity there is strength and the harmonious and loyal co-operation of central station, manufacturer, dealer and various engineering organizations and associations have played their part in making possible the unprecedented progress of the electrical industry.

That the gas industry is alive to the situation, and no one can fail to realize the potentialities of the electrical industry nor ignore its rapid growth, should act as a further incentive to the electrical industry as a whole. It has set the pace, and with the advantage of a good start should not only maintain but force the issue. Let others emulate but the electrical industry must continue to initiate in new and better methods for getting business and publicity propaganda.

It is with gratification in which disconcertion is unalloyed that the electrical industry hears the gas interests implored to imitate their business-getting methods in vying for future business. We are not afraid. The gas industry is about 100 years old, and our senior by 203 per cent it is true. It has an invested capital of some $1,100,000,000 which is only 45 per cent of that invested in the electric lighting industry.

We are not afraid. Each year's achievements act as stimuli for greater action in the years to follow. Thus has the electrical industry grown as it must continue to grow for many years to come. We are strong in the knowledge of our youth and strength, secure in the history of our growth and optimistic for the future that lies bright before us.

An Important Field of Investigation

THAT the carrying capacity of cables in ducts should be investigated comprehensively was a point well made in a recent public utility commission hearing where the investment in particular classes of service was undergoing examination. It was pointed out that comparatively little thorough and reliable information is extant in relation to the phenomena of heat liberation and dissipation in underground ducts, the relation of cable size to load variations, season of year, and other conditions. While it is generally appreciated that under winter conditions the carrying capacity of cables exceeds their safe loading during the summer season—and this is fortunate for companies with winter peaks—much yet remains to be learned relative to the heating of cables on typical distribution systems with actual quantitative measurements the basis for future designs and installations.

In mentioning this opportunity for useful research, it should be noted that the power-factors of the individual lines studied has a very close relationship to the load capacity of such cables, and consequently affects the investment necessary to provide for a given service. In the hearing where cable heating came up for brief consideration, one of the commissioners took the ground

that the question of power-factor on any underground cable system should not be admitted as having any bearing upon the making of the rate; but engineering testimony soon introduced rightly emphasized the connection. Low power-factors mean more copper for the same loss and more copper means a higher investment to render a given service, and consequently a larger principal upon which to earn revenue. There is no escaping the physical limitations imposed upon alternating-current systems by power-factors slumping below unity. This and many other elements bearing upon loading capacity may well be investigated in the interests of that closer fitting of engineering materials to the service requirements which marks the advance of the science of applied electricity.

Our National Journals and A Low Postage Rate

THE rejection by Congress of the provision in the Post Office Appropriation Bill, increasing the postage rate upon periodicals is both just and wise. The passage of such a bill would impede national development, retard progress and lower the efficiency of the individual and nation as a whole. The taxation of our journals by imposing an increased rate of postage is not a matter affecting the publisher and subscriber alone, but one with which the nation as a whole is concerned, and very closely. Many of the journals are a national asset of a high order for they are doing a magnificent work in the service of the country. The imposition of increased postage would restrict circulation, place an additional burden upon the publisher and one which would have to be borne eventually if not immediately by the reading public. As it is, the present high price of paper is working a hardship with many of the nation's periodicals; in some instances subscriptions have already been increased, in others circulation curtailed and reading matter retrenched to the detriment of the publisher, the subscriber and the advertiser.

The work of many of this country's journals is not merely individual but national. Perhaps no two things have done more to bring North and South, East and West close together than have the railroads and the nation's journals. By means of low postage rates it has been possible to dispatch these journals broadcast over the country, placing them within the financial reach of everyone. Many of these technical journals, whether in the field of engineering, medicine, law, art or any other domestic, industrial or scientific sphere of endeavor, are fulfilling a function impossible to evaluate. They are circulating knowledge and experience, creating inspiration, building incentive from the example set by others, and making possible the intimate exchange of ideas. To the credit of the technical journals in no small measure is due the rapid development of civilization and human progress of the last decade. The technical journal brings one into intimate contact with the world's work, and dreams and aspirations and accomplishments of others; through it you learn what the world is doing, how it is doing it and why. The technical journal imparts information, it suggests, inspires, creates and guides. Surely this is the most efficient manner of using knowledge, and permits of its utilization to the best advantage.

The technical periodical is not a luxury. It is a necessity. It is necessary to the engineer or anyone else endeavoring to keep abreast in his profession or calling and obtain eminence in his domain. To remain uninformed today is not merely to stagnate, but is to fall behind. Things move with such rapidity in these days that one must either keep pace or be lost in oblivion. One cannot mark time. New methods and new demands, new ways of meeting old needs arise and make the rapid circulation of knowledge of greater necessity and value now than it ever was before.

Postage rates have frequently been reduced between this country and foreign lands that this country might bring itself nearer other countries in thought and act. Surely it is a shortsighted policy to differentiate between the citizens in one part of the country and another by restricting the distribution of knowledge, retarding the circulation of news of the progress of the world of commerce and of men, by imposing a cost for mailing that will remove this news from a large portion of the country's citizens. Is this not an act to foster sectionalism, which the journals and cheap postage have done so much to overcome?

Statesmen, politicians and captains of industry have long implored co-operation for industrial and national preparedness, for the mobilization of our industries to meet competition from afar, that we might go out and conquer the markets of the world. Others are clamoring that we conserve our natural resources by using them to better advantage. Neither co-operation nor efficient performance nor conservation of material or effort can be accomplished by the hoarding of ways and means. It has been said that "efficiency is the power of doing one's most and best in the shortest time and easiest way to the satisfaction of all concerned." But how can this be accomplished where a premium is placed upon ignorance, where sectionalism is encouraged and the distribution of information and knowledge hindered?

The passage of the Postal Bill at a time when the country needs most its talent, efficiently mustered for intensive co-operative service would be deplorable. The Postal Bill is anathema to conservation and the mobilization of the national industries. It would stunt instead of hastening and encouraging individual and national growth. The Postal Bill is a mistaken, shortsighted retrogressive piece of legislature, which if passed, would prove costly to the individual, the community and the nation. It would almost disastrously hamper what is probably the chief medium for the prompt dissemination of knowledge that is so essential to continued national progress.

HAPPENINGS IN THE INDUSTRY

Dayton New-Business Meeting—Consolidation in New York—Rate Regulation Discussed in Chicago—Plans for Extensions in Chicago—Program for A. I. E. E. Chicago Meeting—Extensions in Texas—British Views on Depreciation—Advantages of Centralized Energy Supply—Miscellaneous News Notes

PROGRAM FOR OHIO NEW-BUSINESS COMMITTEE MEETING.

Various Phases of Central-Station Service to Be Discussed at March Meeting in Dayton.

A meeting of the Committee on New-Business Co-operations, of the Ohio Electric Light Association, will be held at the Miami Hotel, Dayton, O., on March 14. A number of interesting papers and discussions have been arranged for and it is expected that the meeting will be one of the most successful in the history of the Committee.

The program will open with an address of welcome by Judge E. P. Matthews, vice-president of the Dayton Power & Light Company. This will be followed by two papers as follows: "Financing Motor Installations," by F. I. Woltz, power engineer, Union Gas & Electric Company, Cincinnati, O., and "Free Service," by O. A. Achuff, new-business manager, Massillon Electric & Gas Company, Massillon, O.

Luncheon will be served in the Breakfast Room of the Miami Hotel, after which there will be an address on "Salesmanship," by A. F. Siebert.

At the afternoon session there will be three papers as follows: "The Manufacture of Raw-Water Ice," by A. M. Heritage, refrigerating engineer, Triumph Ice Machine Company, Cincinnati, O.; "Commercial Rates," by E. T. Hollingsworth, commercial manager, Ohio Light & Power Company, Newark, O., and "Motion-Pictures as an Aid to New Business," by F. H. Hooper, new-business manager, North Western Ohio Light Company, Van Wert, O.

J. E. North, of the Springfield (O.) Light, Heat & Power Company, is chairman of the Committee.

CONSOLIDATION OF UTILITIES IN NEW YORK.

Richmond Light & Railroad and Midland Railroad Ask Permission to Merge.

The Richmond Light & Railroad Company and the Staten Island Midland Railway Company have jointly applied to the Public Service Commission for the First District, New York, for permission to consolidate their several activities in a corporation to be known as the Staten Island Light & Traction Company, Inc., and to issue certain securities in connection with the consolidation. The hearing was set March 5. A petition filed with the Commission sets forth that the two companies entered into a joint agreement on December 1, 1916, to form a new corporation. Both companies operate street cars in Staten Island and the Richmond Light & Railroad Company is also at present engaged in the manufacture and sale of electrical energy.

The two companies asked the Commission for authority to execute a mortgage to secure $7,500,000 face value first and refunding mortgage 6-per-cent gold bonds and for permission to the new corporation to issue $1,350,000 par value of 6-per-cent cumulative preferred stock and $3,291,000 par value of common stock. In addition the Midland company asks for authority to increase its capitalization from $1,000,000 to $2,350,000 before the consolidation; $1,350,000 to be preferred stock and $1,000,00 common stock.

SHORTCOMINGS OF RATE REGULATION BY COMMISSIONS POINTED OUT.

Address by W. J. Norton Before Joint Meeting of Electrical Engineers in Chicago.

On the evening of February 26, a joint meeting was held in Chicago by the Electrical Section, Western Society of Engineers, and the Chicago Section, American Institute of Electrical Engineers. William J. Norton made an address entitled "The Making of Rates After Valuation." In opening, Mr. Norton said that any remarks he would make would be in the spirit of friendly criticism of commission regulation, in which he was a strong believer. In the typical rate cases coming up before state utility commissions there are five essential elements: (1) valuation; (2) rate of return; (3) current operating expenses; (4) deferred operating expense; (5) operating revenue. Heretofore, an extraordinary amount of stress has been placed on the first of these elements. The subject of valuation has been discussed pro and con for years and there is a mass of literature on the subject. The commissions have used the valuation almost to the exclusion of the other elements that are essential in a proper consideration of rate cases. In the hearing of such cases nearly all of the time is devoted to taking testimony on the valuation, which sometimes drags over a period of a year or more, so that all parties in the case are so completely tired of the controversy that they are glad to have it concluded in the shortest possible time. Consequently but little consideration is given to proper rate of return, analysis of operating expenses, consideration of deferred operating expenses, which Mr. Norton prefers as a better designation for what is usually expressed by depreciation. This results, particularly in electric cases, in a haphazard setting of the rates.

Without attempting to minimize the importance of valuation, Mr. Norton wished to emphasize the need for more careful consideration of the other elements involved The rate of return, which in so many cases has been set arbitrarily without proper consideration, is a matter on which the commissions assume a great deal of responsibility. The arbitrary setting of this return is not equitable. Few investors understand the significance of state regulation on this matter and Mr. Norton feared that the attitude of most of the commissions on this point would seriously hamper utilities in rendering proper service. There are but two state commissions, namely, those of California and Maryland, which have taken a liberal stand on this point. The commissions should realize that they are obliged to secure the best possible service at reasonable rates, istead of only passable serviceable at the lowest possible rates. The present tendency does not encourage a utility to develop the highest possible efficiency, because if it does so it is likely to be penalized by serious reductions in rates which will lower its rate of return. What is needed is to guarantee the utilities a higher rate of return above a definite minimum in proportion to the efficiency shown in the management and operation of the utility.

The operating expenses are usually given almost no con-

sideration whatever. There is merely an audit of the accounts which have been compiled and submitted at a great deal of labor and expense. An antiquated form for the annual reports is employed and a mass of voluminous reports is gathered which are practically never referred to. A reasonable and carefully prepared simple form of report would have exceptionally great value. Proper consideration of this point should be given and the company rewarded for efficiency or penalized for inefficiency in the manner referred to above. Respecting depreciation, or deferred operating expense, although much discussion has been indulged in, no reliable data have been compiled because commissions have not yet had a long enough existence to gather the data required over a long period of years. Likewise, little consideration is given to an exact adjustment of the operating revenue. Rates are usually set on a series of assumptions and are not followed up in many cases to see whether the assumptions are borne out by the actual results. A careful cost analysis is of great value and if repeated from year to year would become increasingly valuable. The conclusions derived from this would in time result in a much more scientific system of rate making. In concluding the first part of his paper, Mr. Norton said that the tendency usually is, on the part of the city and the commission, to insist on a reduction of rates to a minimum thus giving the benefit to the public which has done the least to earn it. Fair encouragement must be given to efficiency and to voluntary reductions in rates by the utilities. Excessive importance should not be given to valuation at a sacrifice of proper consideration of the other essential elements in rate making.

In the second part of his address Mr. Norton showed analyses of quite a number of electric rates for different classes of customers in cities of over 40,000 which had been prepared for the National Electric Light Association. He then briefly reviewed the history of state regulation of utilities, which had its early inception in Massachusetts in 1885, but which did not make much progress until 1907. Since that time it has been extended to the majority of the states and the tendency is to give the commissions still broader powers. He made a strong plea in favor of state regulation instead of local regulation or what is frequently referred to as home rule. The tendency for utilities is to increase their sphere of activity and a great many are already interstate in character. The tendency therefore should be toward state or interstate regulation instead of reverting back to local control which usually is not only narrow and one-sided, but is likely to be based on prejudice and improper consideration of the rights of all parties involved.

In the discussion Frank F. Fowle said that from 80 to 90 per cent of the time in most rate cases is spent on valuation, which gives an excessive emphasis on the subject. The rate of return allowed must include not only interest on the capital, but reward to the investor for taking the risk. A careful cost analysis is necessary for determining the efficiency of operations. Although this is a very difficult feature, he felt that encouragement must be given for efficient operation. More experience is necessary to determine proper allowance for depreciation and for making more correct assumptions as to the effect resulting from proposed changes in rates.

P. Junkersfeld said that it was necessary to consider the fundamentals of the problem. The earnings of the utility are of interest to the investing public, whereas the rates and service are of interest to the consuming public. Both of these considerations must be taken care of. It is necessary to secure adequate service at reasonable rates, which means adequate return to the investors, so as to secure the necessary capital for extensions, etc. State regulation is much preferable to local regulation.

Harold Almert spoke of many of the inherent difficulties of commission regulation and of the confusing elements that have a tendency to muddle the problem. In a reasonably well conceived and conducted utility the investors should be allowed a fair return on their investment for the time it is used. He also spoke of the peculiar attitude shown and the absurd contentions frequently presented in rate cases. The high cost of making valuations is another serious hindrance to proper consideration of rate cases.

C. F. Elmes discussed the disadvantages of the prevailing flat-rate system of gas companies and the peculiar difficulties which they have to contend with. Most gas companies have something like 80 per cent of their output furnished to a myriad of small consumers and only about 20 per cent to large consumers, whereas electric utilities in the larger cities at least, have the conditions almost practically reversed. He spoke strongly in favor of a profit-sharing scheme as a possible solution of a proposal to reward the utility for efficiency. In England the attitude on what is a reasonable rate of return is much more liberal than in this country.

A. C. King stated that because commissions feel that their findings are subject to review by the courts, who follow precedent so closely, they also have developed a tendency to follow precedent blindly and seem to fear to branch out in new directions. The discussion was also participated in briefly by L. K. Sherman and Mr. Norton

EXTENSIVE PLANS FOR BETTERMENT OF CHICAGO'S STREET-LIGHTING SYSTEM DURING 1917.

Over Two and One-Quarter Million Dollars to Be Spent for Extensions and Improvements.

Mention was made in these columns about eight months ago of a general plan for an important extension of the street-lighting system of the city of Chicago. On June 5, 1916, the voters of the city approved a proposed bond issue of $3,750,000 to provide for these extensions to the municipal system. Plans for this undertaking were developed during the latter part of last year and during recent months, so that Commissioner of Gas and Electricity William Keith announces that the bulk of the proposed extension will be carried out this year.

In general it is proposed to devote this year to complete reconstruction and rehabilitation of the street-lighting system in four districts in particular in which the lighting now is either inadequate or of an unsatisfactory type. Two types of lighting equipment will be used. For business and street-car-line streets, 600-candlepower lamps, mounted at a height of 22 feet above the street surface, will be used. In well developed residence districts where there are a great many trees on the streets that necssitate a low mounting of the lamps, 100-candlepower lamps fed from underground armored cables will be used. All of the lamps are to be of the gas-filled tungsten type. The general scheme of lighting will conform to that described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of September 6, 1913.

In what is known as the Northwest District there will be installed 413 additional 600-candlepower lamps at new locations on business and car-line streets, and a total of about 6,000 100-candlepower lamps will be placed on residential streets. A substation building will be erected and the necessary transmission and feeder circuits and equipment provided. This district now has a large number of gas and gasoline lamps and also several miles of entirely unlighted streets, all of which will be equipped with standard electric equipment. The total expenditure in this district will be about $825,907.

In a district on the South Side fed from the R. A. Waller substation, there will be installed 362 additional 600-candlepower lamps and about 6,600 100-candlepower lamps, together with the necessary substation equipment, feeder cable, conduits, etc., entailing a total expenditure of about $623,218.

In what is known as the Wabansia District on the West

Side, 60 additional 600-candlepower and 1,135 100-candlepower lamps will be installed at an estimated cost of approximately $141,971.

In the South Chicago District there are now about 500 rented arc lamps which will be displaced by an equal number of 600-candlepower tungsten lamps. In addition there will be installed 1,100 of the latter type of lamps and 3,000 100-candlepower lamps. The improvements in this district involves an estimated total cost of $684,455.

Arrangements are also being completed for securing additional power for the operation of the lamps added. The present street-lighting system of the city is supplied with energy from the hydroelectric system of the Sanitary District of Chicago and as the latter cannot supply the additional energy needed for the extension of the city's system, the Department of Gas and Electricity will secure the required energy from a new plant, which is being erected by the Department of Public Works for supplying energy for light, heat and power for the large group of municipal buildings in the vicinity of Marshall Boulevard and Thirty-first Street, including the city prison, the new contagious diseases hospital and the new group of city shops and warehouses. This plant, work on which has already begun, will include two 3,000-kilowatt turbogenerators, two 500-kilowatt units and one 200-kilowatt unit. The two larger units will perhaps not be in operation for nearly a year. When completed, it is expected that this plant will furnish about 4,000 kilowatts for the street-lighting system.

Despite the high prices prevailing for electric equipment, it is expected that the extension of the street-lighting system, as outlined above, will be made at less expense than was formerly anticipated, because the method in use heretofore has been to add to or rehabilitate only portions of the system as the funds were made available from year to year. The bond issue authorized last year, however, makes it possible to undertake a practically complete rehabilitation of the city's system in such a manner as to secure much more advantageous circuit layouts and other improvements than were possible under the former system. In the line of general improvements to the system, aside from those referred to in the four particular districts, it is expected to expend about $30,173, thus making a total expenditure during 1917 of about $2,305,724 for betterments of the entire system.

REPORT SHOWS PURCHASED POWER CHEAPER THAN MUNICIPAL PLANT.

Nashville Committee Recommends Energy Be Secured from Local Central Station.

The public utilities committee of the Engineering Association of Nashville, Tenn., which is engaged in reviewing engineering features of reports made some time ago by a firm of engineers and auditors which investigated the city's affairs, has presented a report suggesting that before a contemplated bond issue is made for new boilers in the city's lighting plant, the mayor ascertain whether it would not be cheaper to purchase current from the local lighting company. The committee declares that both on account of the condition of the metals market and the condition of the city treasury, no machinery expenditures not absolutely necessary ought to be made.

The report made by James Cameron and staff, of New York, reviewed by the committee, showed that the cost of operation of the municipal plant in 1915, including loss of taxes and other items, was $16,000 greater than the cost of purchased current would have been. If the present plant were retained for stand-by service, the cost of buying current would be greater, but a small reduction per kilowatt-hour by the public service company, would have resulted in a saving over the cost of operating the municipal plant.

If the plant is sold at this time, enough could be obtained to retire all bonds and leave a surplus. For this reason, a full investigation of possibilities is advised.

QUESTION-BOX CONVENTION OF NEW ENGLAND SECTION.

Annual Meeting to Be Held at Boston, Mass., March 7 and 8.

The New England Section, National Electric Light Association, will hold its third annual question-box convention at the Engineers' Club, Commonwealth Avenue, Boston, Wednesday and Thursday, March 7 and 8. The sessions will be divided among the various particular interests of central-station men, and judging from the two conventions of previous years, will yield important results for the industry.

PROGRAM FOR CHICAGO MEETING OF AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Interesting Papers to be Presented Under Auspices of Protective Devices Committee.

The 330th meeting of the American Institute of Electrical Engineers will be held in Chicago on March 9, with headquarters at the Hotel Sherman. A number of interesting inspection trips have been arranged for Friday and Saturday and among the points to be visited are the newer substations of the Commonwealth Edison Company, the electric-furnace installation at the South Chicago plant of the Illinois Steel Company, the plant of the Western Electric Company at Hawthorne and a number of Bell telephone exchanges.

The technical session will be held at 8 p. m., at which a paper will be presented by Philip Torchio, of the New York Edison Company, entitled "Relays for High-Tension Lines" and a paper by R. F. Schuchardt, of the Commonwealth Edison Company, Chicago, entitled "The Protective Relay Equipment on the System of the Commonwealth Edison Company."

The meeting will be preceded by an informal dinner in the Crystal Room of the Hotel Sherman at 6:30 p. m.

IMPORTANT NEW CENTRAL-STATION WORK TO BE UNDERTAKEN IN TEXAS.

Numerous Line Extensions to Take Care of Additional Electric Range Business a Feature.

One of the most important pieces of work which will be undertaken in Texas this year will be the installation of a 15,000-kilowatt Curtis turbo-generator set at the power plant of the Fort Worth Power & Light Company, Fort Worth, Texas. This generator is on order at the present time but will not be shipped until early in 1918. Construction work, however, will be started prior to that time and everything will be ready when the unit arrives. This company supplies power to the transmission line of the Texas Power & Light Company and it is due to the large increase in power business, secured by the latter company as well as additional business in Fort Worth, which makes this new capacity necessary.

The Texas Power & Light Company is now working on an extension of its transmission line from Brownwood to Commanche and Dublin. The Brownwood-Commanche line is already in operation at 60,000 volts. The line to Dublin will also be 60,000-volt construction, but will be operated at 22,000 volts for the present. The length of the line is about 60 miles. It is planned to eventually connect this line with the company's main transmission system in central Texas.

The local electric plant at Henrietta, Texas, has been purchased by the Wichita Falls Electric Company and plans are being made to construct a transmission line from Wichita Falls to Henrietta to serve this town. This will probably be 60,000-volt construction.

The Texas Power & Light Company is planning a general reconstruction of many of its distributing lines to take care of additional electric-range business. Plans have been laid to sell over 2,000 electric ranges this year.

MASSACHUSETTS COMMISSION RESTRICTS STOCK ISSUES.

Orders Fewer Shares of Stock But Higher Selling Price in Recent Decisions.

In three instances recently the Massachusetts Gas and Electric Light Commission has ordered a higher selling price per share, together with a corresponding decrease in the number of shares authorized, in response to petitions for additional stock issued by lighting utilities. The most recent decisions concern the Haverhill Electric Company and the Springfield Gas Light Company. The former asked approval of 2,312 shares at $130, and the Commission approves 1,714 shares at $175. In the Springfield case 2,962 shares were asked for, at $200 per share, and the Board approves 2,429 shares at $225. Stock of the Haverhill company recently sold as high as $210, and of the Springfield company at $260, the Commission says. In each case the Board holds that the price fixed by the directors is lower than will insure a ready market for the stock and too low to be consistent with the public interest.

The Haverhill company has made additions to the plant since March 31, 1913, not covered by stock issues heretofore approved, that may be properly converted into permanent capital, to the extent of $95,000. The estimated cost of completing work in progress on June 30, 1916, including the cost of an additional 5,000-kilowatt generator, was over $176,000. Extensions of the distribution system during the past summer and fall were estimated to cost over $18,000, and for the coming summer $31,000 more.

DAYTON JOVIANS TO HOLD BANQUET.

Many Notable Addresses Scheduled for Meeting On March 14.

Coincident with the meeting of the New Business Committee of the Ohio Electric Light Association, in Dayton on March 14, the Dayton Jovian League will hold a banquet at the Miami Hotel at 6:15 p. m. A very elaborate program has been arranged and delegates to the committee meeting are invited to attend.

The following are the speakers: James M. Cox, governor, State of Ohio, on "Present-Day Conditions"; H. M. Waite, city manager, city of Dayton, on "City Manager Form of Government"; J. E. North, chairman, Committee on New Business Co-operation, Ohio Electric Light Association, on "The New Business Committee of The Ohio Electric Light Association"; W. W. Freeman, president, Union Gas & Electric Company, Cincinnati, O., on "Relation of the Public Utilities to the Public"; C. R. Kettering, vice-president, The Domestic Engineering Company, Dayton, O., on "Future Applications of Electricity"; F. R. Coates, president, the Toledo Railways & Light Company, Toledo, O., on "The Public Be Pleased"; and Judge R. W. Baggott, Court of Domestic Relations, on "Selling Juice."

RHODE ISLAND CENTRAL STATION REPORTS LARGE GAINS.

Many New Extensions Made Necessary by Unusual Development in Providence.

The annual meeting of stockholders of the Narragansett Electric Lighting Company, Providence, R. I., was held February 20. The directors were authorized to issue $1,500,000 of new stock, if deemed advisable.

The total energy sales for the year were 61,893,000 kilowatt-hours, an increase of 36.39 per cent over 1915. Gross earnings were $1,986,695 in 1916, an increase of 12.14 per cent.

During the year preparations were made for the installation of a new 35,000-kilowatt turbogenerator, which will cost installed about $450,000. In March the company began to exchange current with the Rhode Island Power Transmission Company, a subsidiary of the New England Power Company. The transmission company supplies current to large power customers in Providence.

The Westerly Light & Power Company and the Mystic Power Company were purchased last July, and their territory added to the system. A new transmission line will be built in this district.

Consulting engineers have made a study of the distribution system as a whole and recommend extensions to meet the remarkable growth of the company's business. During 1916 poles and wires were removed from three miles of streets and underground construction substituted.

Necessity for a larger reserve supply of coal has resulted in enlarged storage space being taken. A 2,500-kilowatt rotary converter was recently installed in the Dyer Street substation at a cost of $33,900.

Total additions to plant in 1916 cost $595,653, and of this $153,559 was for additional transmission lines. A high-tension line is being constructed to supply the street-railway system.

IMPORTANCE OF ENGINEER, FINANCIER AND ACCOUNTANT IN COMPUTING PLANT DEPRECIATION.

British Electrical Engineers Discuss Need for Co-operation Between Various Interests in Determining Plant Value.

In January the English Institution of Electrical Engineers, at its London and provincial sections, discussed the principles involved in computing the depreciation of plant, a joint paper by F. Gill and W. W. Cook serving to introduce the matter. The authors said that the only points upon which all writers on depreciation seemed to be agreed were: That the matter was one of great importance, and that the term "depreciation" was loosely employed and had various meanings. It was not satisfactory that engineers should hold such divergent views on so important a question. Too often it was regarded as one for the accountant alone whereas it really concerned the engineer, the financier, and the accountant, no one of them being competent to settle it in any particular case; in order to obtain correct results there must be co-operation between the three. Each of the three parties must study the question in all its bearings for it was just as important that the engineer should understand the financial aspect as it was for the others to follow the engineer's methods in his share of the work. Messrs. Gill and Cook saw no reason why there should not be general agreement, for it was so largely a question of fact. Everybody recognized the necessity for making some provision for depreciation. All plants had a limited life; at the end of its life it was worth nothing except the value of the material as scrap, and it was clear that, from the moment it was first brought into use to the end of its life, a process of diminution in value was going on continuously. The authors by the term "depreciation" intended to cover: (1) Provision for the diminution in value of plant in place and working (that was, its loss in value to the owner as a continuing plant), by reason of causes outside his control, such as age, wear and accidents; this they termed renewals." (2) Provision to enable the owner to take plant out of commission before its physical life was exhausted in cases where, from either progress of the art or growth of the business, it was economically advisable to do so (that was, by reason of causes within his control); this provision they termed "improvements."

Discussing the principles which govern the question, primarily from the engineer's point of view, the functions of the three classes were stated thus:

The engineer: To provide the information necessary re-

garding the plant, such as first cost, residual value, and life.

The financier: To provide information regarding the money, the amount available, the rate at which it could be borrowed, and the rate that could be obtained for the loan of it.

The accountant: To provide accurate records based on decisions arrived at and to see that the real results were neither disguised nor hidden.

All three must come to a common decision and each in any calculations he had to make must work to it, otherwise nothing but chaos could result. The common method was best studied in the annual charges for plant, determined in advance of construction. To determine the amount in the annual charges for depreciation it was necessary to estimate the first cost, residual values, and the physical and economic life of the various classes of plant. It was also necessary to fix the treatment of the capital account and to estimate the charge for return on capital. The interest to be earned by the reserve funds must be credited to its source. The reserves were preferably handled by means of two funds as follows: (a) A renewals fund for providing the necessary money at the end of the physical life, that was, the end of the period during which the plant would give its service satisfactorily under all conditions outside the owner's control. (b) An improvements fund for providing sufficient additional money to enable the plant to be taken out of commission for reasons within the owner's control and while it was still giving its service satisfactorily. The calculation of the amounts to be contributed to these two funds must include the interest which should be earned by the money before it was required at the end of the life. The amount, calculated in this way, which should be in the renewals fund gave the correct diminution in value, when considering the value to the owner, of the plant in place, and working, at any period of its history. The amounts, thus calculated, which should annually be put to the two funds, renewals and improvements, determine the correct depreciation charge against the undertaking for the purpose of assessing profits, fixing rates, and under certain conditions, assessing the value of an undertaking as a going concern. The sinking fund method fulfills all the requirements; the straight line method does not. All estimates such as first cost, physical and economic lines, and interest earned by funds, will require revision from time to time either as a result of experience or of changes in conditions.

MUNICIPALITY'S DEBT TO PUBLIC UTILITIES SHOWN.

Drastic Massachusetts Bill Would Permit of Municipal Competition.

Several measures affecting electric lighting interests were heard by the Public Lighting Committee of the Massachusetts Legislature February 19. Two bills provided for the more ready acquisition of municipal plants. House bill No. 1210 proposed to substitute one vote of a majority of the city council for two votes of two-thirds majority in successive years, as a preliminary to the referendum of voters on the acquisition of municipal plants.

Representative Morrill of Haverhill, proponent, argued that the two-vote provision gives opportunity for opponents of municipal operation to defeat such a proposition by bringing about the defeat of council members favoring the plan.

Bill 1211 provides that a city or town voting to establish a municipal plant may proceed to construct, without the necessity of negotiating for the existing plant. Owners of private plants would not be required to sell, or the city to buy, and corporation and municipal plants would thus be permissible in competition with one another.

A. E. Pillsbury, for the gas interests, and W. R. Peabody and E. W. Burdett for electric companies, branded this proposition as unfair to the financial interests, and dangerous from the standpoint of the community. This is the sixth year the same bill has been brought in and reported on adversely.

Present law provides for the fair indemnification of a plant taken by the city or town entering municipal ownership. Purchase and sale are compulsory, the price to be fixed by arbitrators selected in the usual manner. The Massachusetts statute differs from that of other states in that most of the latter require the Public Service Board's certificate of public necessity before a city can construct or acquire a plant.

Mr. Burdett pointed out that the entrance of the electric lighting industry had greatly benefited the community life, in that it had replaced extra police and firemen and made life more worth living. The public should therefore be fair in its relations with those who early risked their money in a then doubtful enterprise.

ADVANTAGES OF CENTRALIZATION IN ENERGY SUPPLY DEMONSTRATED.

Experiences in Great Britain Because of War Show Many Economic Benefits from Tying Together of Supply Systems.

By Albert H. Bridge.

Following upon the urgent advice of the British government in favor of the interlinking of existing supply stations wherever desirable and reasonably practicable, preliminary conferences have been held and measures recommended from which important results are anticipated. As was stated in these pages a few months ago, the first scheme is that of the Lancashire and Cheshire Committee; this proposal actually anticipated the issuance of the government notice, and the committee has already drawn up a bulky interim report on its investigations. It is satisfied that very substantial economies can be effected by the interconnection of a number of specified undertakings in its area and recommends the holding of a conference of all concerned, at an early date. It further proposes that the Board of Trade be asked to appoint a joint committee or board under the Electric Lighting Acts to act on certain specified lines, and to be armed with powers to enable agreements to be entered into with the bulk power supply companies whose inclusion in the scheme is regarded as essential. Pending the appointment of such a board it is suggested that the undertakings that are favorably situated for interconnection should be empowered to enter into voluntary arrangements therefor, any capital outlay involved thereby being recoverable from the joint committee or board, the local authorities also to appoint their own joint committee to consider proposals for the provision of mains or other interconnecting works.

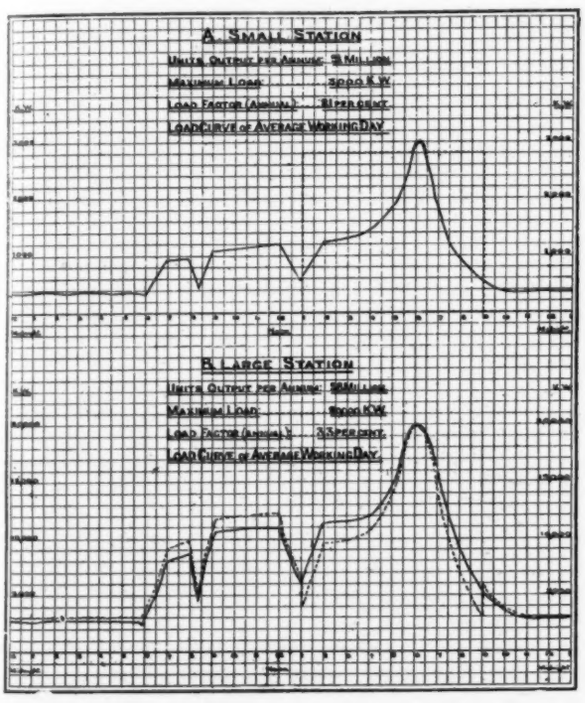
While this Lancashire and Cheshire scheme is more advanced in the matter of investigation, it will of course form part of the great national movement which is being developed by the National Committee that has been sitting for several months. This committee consists of certain eminent members of the Incorporated Municipal Electrical Association and the Association of Electric Power Companies, and it has just published its preliminary conclusions. It says that the importance of linking-up several large stations, and equally of linking-up large stations with small ones, where such consolidations can be carried out without undue capital expenditure, is now becoming more generally realized. It shows that linking up will save fuel and labor, will increase the security of supply, and will in future make for economy of capital. It favors consideration of the subject broadly from the national point of view, having in mind not only the saving of fuel but the interests of consumers in obtaining a cheap supply of electricity for all purposes. It holds that the linking up

of many existing stations could be carried out immediately without further legislation and proposes the appointment of local committees of electric supply men in different districts in order that the local problems may be properly understood. While generation as distinct from distribution must be considered broadly, and irrespective of present authorized areas of supply, the "existing rights" must be respected and existing areas must not be interfered with as regards distribution.

A conference has been convened at which municipal and private light and power plants will be represented for the express object of forming the above local committees. It will fall to these committees to consider: the best methods of inter-linking the existing generating stations with a view to more economical operation and to the better security of the supply; the best means of providing capital required for the plant and mains necessary for the equitable allocation of the same; and the best methods of payment between undertakings for any current supplied or interchanged.

Results of Unification.

In calling the conference, the National Committee gave two examples of actual results attending linking up. One of these was of two power stations, each carrying about 7,000 kilowatts of load, linked up at a cost of $15,000, the link having a capacity of 3,000 to 4,000 kilowatts. Here it was found that by shutting down one station each night (12 midnight to 6 a. m.) and week-ends (from noon Saturday to 6 a. m. Monday) the plant load-factor at each station was increased from 67 to 72 per cent, while the total saving of coal per annum in both stations has been 2,000 tons, and is expected to reach 3,000 tons. In the second example a power station having a maximum load of 2,000 kilowatts was linked up with another power station having a maximum load of 15,000 kilowatts. During the second year of working linked-up, the coal consumption of the smaller station was reduced by 2.25 pounds of coal per kilowatt-hour on all units generated by that station. The combined saving of coal, due to interchange of current, in the second year of working, amounted to 5,000 tons. The other advantages experienced were: greater security of supply; reduction in the number of shifts run and wages paid; reduced maintenance charges due to fewer plant-hours run; facility for carrying out repairs when stations are shut down; and there will be a saving in future capital expenditure owing to reduced amount of standby plant and the use of larger generating units.


A. SMALL STATION
MAXIMUM LOAD 3000 K.W.
LOAD FACTOR (ANNUAL) 67 PER CENT.
LOAD CURVE OF AVERAGE WORKING DAY
B. LARGE STATION
LOAD CURVE OF AVERAGE WORKING DAY

Curves Showing Results of Centralization of Power Supply.

The question of the most economical utilization of fuel supplies is of first importance as the United Kingdom is furnishing coal supplies to other European countries which are greatly in need of the same, and, under stress of war, governmental encouragement is to be given to any scheme which will prevent wasteful consumption. One of the directions for an extension of the problem of the inter-linking committees consists in avoiding the waste of the valuable constituents and by-products of coal. The National Committee recognizes that this object can only be attained in a satisfactory way by treating the coal at central points on a large scale. Electricity offers by far the most economical and convenient method of distributing the power from these centers. This point was discussed once more by R. A. Chattock, city electrical engineer of Birmingham, in his address as president of the Birmingham Association of Mechanical Engineers in October. Mr. Chattock has long advocated nationalization of England's electricity supply, and in the course of his address, in which he considered the industrial outlook of the nation, he dwelt upon the essential character of electric supply as a factor in manufacturing production, especially for driving factory equipments economically, and as a means of economizing national fuel consumption. Super-power stations consuming coal at the mine and supplying energy for long-distance transmission to required industrial areas were advocated, compulsory powers exercised by the government appearing to be the quickest way in which such a scheme could be carried through. In such ways, Mr. Chattock holds the proper conservation of coal supply would be secured, but another consequence would be the elimination of smoke from the atmosphere.

Herewith, are given diagrams and descriptive notes illustrating an arrangement advanced by the National Joint Committee as being likely to be found applicable to many actual cases in the United Kingdom.

Practical Examples of Linking Systems.

A power station (A) having a maximum load of 3,000 kilowatts links up with another (B) having a maximum load of 20,000 kilowatts. In the diagrams the dotted lines show how the two stations should be run after linking-up. It will be seen that the arrangement would not only result in a saving to the nation of 2,500 tons of coal per annum, but a saving to the two undertakings of say $15,000 per annum, including wages, etc., which would give a return of 10 per cent, even if it cost $150,000 to connect up.

(A) runs for eight hours (one shift) a day only (and possibly not at all on Sundays), (B) taking the load during the remaining 16 hours. During the eight hours when (A) is running, which would include (A's) peak load, (B) would transfer to (A) sufficient load to keep (A) at a uniform load of 2,800 kilowatts except at the hours when (A's) own load is 2,800 kilowatts and over. Such a division of load would result in maintaining (A's) output at 5,250,000 kilowatt-hours while increasing the plant load-factor threefold, (B's) load-factor remaining unaltered, while the units delivered from (A) to (B) during the eight hours when (A) is running would be returned by (B) to (A) during the remaining 16 hours.

Advantages.

(1) Fuel saved; because (A's) load is always sufficient to enable all machines running to be run at most economical load, and (B) gets a better load during the slack hours. A saving of one pound of coal per unit on 5,500,000 kilowatt-hours is equivalent to 2,500 tons per annum, or, at present prices, say, $7,500 to $15,000, depending upon the locality.

(2) Wages saved; because (A) works one shift instead of three, thereby saving more than half his wages bill and reducing his maintenance charges (because of fewer plant hours).

Miscellaneous NEWS NOTES

Texas Power & Light Holds Managers' Meeting.—A meeting of the district managers of all the properties of the Texas Power & Light Company will be held in Dallas, Texas, on April 24 and 25, in connection with the meeting of the Southwestern Electrical & Gas Association.

Massachusetts Commission Restricts Coupon Notes.—The Massachusetts Gas and Electric Light Commission has asked the Legislature to enact a law to prevent gas and electric companies from issuing coupon notes and other evidences of indebtedness payable at periods of more than 12 months after date of issue, without the Board's approval. A public hearing would be required on any petition seeking such authority, according to the new law.

Washington Section of National Electric Light Association Formed.—A Washington section of the National Electric Light Association was formed by employees of the Potomac Electric Power Company. More than 100 members of the Potomac company became members of the organization. John C. McLaughlin was elected chairman of the new section; J. H. Ferry, vice-chairman; H. A. Brooks, secretary, and E. W. Whitehead, treasurer.

Development of Graphite Deposits Opens Field for Electricity.—Recent activity in the development of the graphite deposits of Alabama is resulting in a demand for power and for equipment for the electrochemical treatment of the rock. A recent announcement of the Geological Survey of the state says that cheap electrical power is a more important factor than transportation facilities. About half a dozen companies have recently been organized for this development.

Stock Issues Authorized and Sought in Massachusetts.—On its petition for approval of a stock issue of $148,000, par value in securities to be sold at $85 per share on $50 par value, by the Fitchburg Gas & Electric Light Company, the Massachusetts Gas & Electric Light Commission has issued an order permitting the issuance of 2,400 shares at $100 each, the proceeds of 2,000 shares to pay notes outstanding last June, and of 400 shares to pay for plant additions made after that date.

The Commission finds that for seven years the company has paid regular 10-per-cent dividends, and recent sales of stock have been at prices over $115 per share. The Board believes that $100 is a fair figure and consistent with the public interest.

The Fitchburg company is one of the utilities under the management of C. H. Tenney & Company, of Boston, Mass.

Electrolytic Behavior of Tungsten.—Walter E. Koerner has carried out extensive experiments and research work under the direction of Dr. C. G. Fink, in the research laboratory of the Edison Lamp Works at Harrison, N. J. He recently made public the results of his investigation in a paper read before the American Electrochemical Society. An interesting feature of the paper was that regarding the use of tungsten in cells. In this connection the author states that for the construction of a voltaic cell with tungsten as the negative electrode it is desirable to use an electrolyte in which both the tungsten and the anodic reaction products are most soluble. With a sodium hydroxide solution as electrolyte, mercury or silver may be used as positive electrode against tungsten as negative electrode. The emf. of such a combination using mercury is 0.49 volt, with silver 0.69 volt. Preliminary experiments with tungsten both as fused slugs and as metal powder were promising, especially those with the latter. Another series of experiments was made and is still being continued on the use of tungsten in standard cells, results of which will be announced later.

Laboratory Methods in Safety Engineering.—James E. Latta, general agent, Underwriters' Laboratories, Chicago, Ill., and formerly connected with the editorial staff of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, will deliver an illustrated lecture before the students of Sibley College, Cornell University, on March 22, entitled, "Laboratory Methods in Safety Engineering."

Rate Reduction by Alabama Power Company.—The Alabama Power Company has announced a reduction in rates in all towns served by the company directly. A minimum rate of $1.00 per month is established, users of 200 kilowatt-hours paying 10 cents per kilowatt-hour; 200 to 500 kilowatt-hours, 7.5 cents; 500 to 1,000 kilowatt-hours, 5.5 cents; beyond 1,000 kilowatt-hours, 5 cents. A 10-per-cent discount is given for payment within 10 days. The former maximum rate was 12 cents. The towns affected are: Albany, Anniston, Ashland, Attalla, Austinville, Camp Hill, Decatur, Dora, Guntersville, Gurley, Hartselle, Hibson City, Huntsville, Jacksonville, Leeds, Lincoln, Lineville, Oxford, Montevallo, Pell City, Ragland, Smith Hill, Talladega, and West Blocton.

Franchise Tax Bill, New Jersey.—The present administration measure, in New Jersey, increasing the rate of franchise taxes for electric, gas and water companies operating in the state, has been introduced in revised form in the Legislature by Assemblyman Oliphant, and is expected to become a law. The bill provides for an increase in the present tax of two per cent to three per cent for the present year, four per cent next year, and a maximum of five per cent in 1919, and applying only to those utility companies whose gross income is in excess of $50,000 a year, thus exempting all of the smaller utilities from its provisions. The law, it is said, will provide about $1,000,000 over the present taxes for the various cities in the state.

Weights and Measures Department to Test Electric Meters.—The superintendent of the Department of Weights and Measures, New Jersey, has made a recommendation to Governor Edge to place the testing of electric, gas and water meters under its jurisdiction upon a revised basis from the present plan employed by the Board of Public Utility Commissioners, and which, accordingly, would eliminate this work from the commission's duties. It is proposed to effect a change in making the company defray a nominal charge for testing instead of exacting a fee of one dollar from the consumer, which is returned should the meter be found in error. It is also held that the services of the department for this work be extended to the users of the meters and eliminate the necessity for the companies, themselves, making tests.

Dayton Company Honors Veteran Employees.—The directors of the Dayton (O.) Power & Light Company gathered at the Phillips House on Thursday evening, February 22, for a very enjoyable dinner in honor of O. H. Hutchings, associate general manager and engineer, and Frank Jones, the head of the arc-lamp department of the company. The purpose of the dinner was to recognize the fact that these two gentlemen had been in the employ of the company for a period of 25 and 30 years, respectively. Mr. Hutchings was presented with a very handsome silver service and Mr. Jones with a gold watch to commemorate their long and faithful service. Judge E. P. Matthews, one of the vice-presidents of the company, in the absence of President F. M. Tait, acted as chairman and made he presentations. Short talks were made by those present and at the close of the evening Judge Matthews read a very interesting letter from President Tait in which he expressed his personal appreciation regarding the services of the guests of the evening.

When Will the Price of Copper Decline?

An Analysis of Present Conditions with Regard to Demand and Supply Indicates No Immediate Hope for Reduction, Even If War Should End

By H. D. HAWKS
Commercial Engineer, United Metals Selling Company

There are so many uncertain and conflicting factors which may affect the price of copper during 1917 that any forecast as to the average price would be of little value. There are a number of facts, however, which it is well to bear in mind. If the war continues for another year, the Allies will again be in the market for a large supply, and the prophecy of 40-cent ingot may be fulfilled, though it seems like an extravagant figure in any circumstance. If the war ends in a few months, the demands of the Allies for copper for war purposes will be greatly reduced. On the other hand, the German market will be opened and Germany is said to need 800,000,000 pounds of copper. It is certain she will not rush into the market at once with enormous orders and drive up the price. She must buy as economically as possible, but the opening of her market will certainly go a long way in offsetting the curtailed demands of the Allies. It should be borne in mind that copper supplies in the allied countries are under strict government control, and are used almost entirely for war purposes. Peace will bring a demand for purposes other than those of war. It will also mark the beginning of reconstruction in all the devastated sections of Europe, and for this there will be needed a great quantity of copper. The fact that a large percentage of the possible production during the first six months of 1917 is sold, must also be borne in mind. On the other hand, we must consider the fact that production in 1917 will probably exceed that of 1916, and that domestic demand is likely to show a falling off. The only safe forecast as to prices of copper during 1917 seem to be as follows: If the war continues for another year the rate of consumption abroad will enormously increase, and the high peak price may run far above that of 1916. If the war ends soon, there will be a sudden lessening of demand and a substantial drop in price, followed by a gradual reaction to higher levels as the peace demand develops. That copper will command a relatively high price as compared with 1913 and 1914 seems inevitable. Moreover, this condition is likely to prevail for several years. From the present outlook cheap copper seems a thing of the past, rather than a thing of the future.—From "Wire Message," issued by Habirshaw Electric Cable Company and The Electric Cable Company.

AN analysis of the copper situation to present facts and matters of interest to the electric light and power companies presents certain difficulties at all times, since the data necessary for a complete discussion of this important question are in part incomplete. It requires keen judgment on the part of those vitally interested in production to maintain the proper equilibrium, and also an equal amount of foresight is required on the part of the consumer in covering his requirements.

Much information is required in solving these situations, and necessary facts are never fully available, because we are always attempting, in some measure, to forecast the future. The producer has to forecast the future in regulating production and the consumer equally in determining when and to what extent to buy. At the present time, the difficulties are greatly accentuated. The principal nations of Europe are now at war with each other and the ordinary relationship of production and consumption have been disrupted, and it is beyond the power of the most astute person to foresee the duration of the war and the readjustments when peace is restored.

We have every reason to believe, however, that the demand for copper will continue heavy. Even if it were practicable now to prepare a complete and accurate analysis of the relationship of supply, demand, mill and refinery capacities, transportation facilities, etc., it would not be entirely worth while, since in the interval between the time of its preparation and its appearance in print extensive modification would become necessary. The component phases governing the picture are varying from day to day. I shall therefore not attempt to do more here than to sketch the general features of the present situation.

Coincidentally with the declaration of war, the consumption of copper increased at an extraordinary rapid rate and is now at the maximum in the history of the metal. The statistics, in Table I, plainly indicate this fact, 1916 showing an increase of 38.9 per cent.

Comparing 1914 and 1916 smelter production, the increase is 877,862,808 pounds, or 76 per cent. Comparing 1914 and 1916 consumption, the increase is 947,000,000 pounds, or 145 per cent.

TABLE I—UNITED STATES COPPER PRODUCTION AND CONSUMPTION.

Year	Smelter Production Lbs.	Annual Increase or Decrease Lbs.	Per cent	Domestic Deliveries
1908	942,570,721	.....	.....	.....
1909	1,092,951,624	I. 150,380,903	15.9	705,051,591
1910	1,080,159,509	D. 12,792,115	1.2	749,426,542
1911	1,097,232,849	I. 17,073,240	1.6	709,611,605
1912	1,243,268,720	I. 146,035,971	13.3	819,665,948
1913	1,224,484,098	D. 18,784,622	1.5	767,351,760
1914	1,150,137,192	D. 74,346,906	6.1	*653,000,000
1915	1,388,009,527	I. 237,872,335	20.7	*1,077,000,000
1916	1,928,000,000	I. 539,990,473	38.9	*1,600,000,000

(*) Estimated.

For matters of analysis and comparison, it is estimated that the U. S. consumption of 1913 may be classified as shown in Table II.

TABLE II—CONSUMPTION IN 1913.

	Pounds	Per cent
Copper wire	400,000,000	52.1
Brass mills	220,000,000	28.7
Copper sheets	105,000,000	13.7
Miscellaneous (chiefly coating and alloys)	42,000,000	5.5
Total	767,000,000	100.00

If we assume the normal business of the country to be as is represented by the year 1913, it will be seen that the war demands have increased our home consumption nearly one billion pounds, and increased mill outputs, roughly, 108 per cent—a remarkable task. It remains to consider:

(1). Whether the increase may be expected to continue.

(2). Are our resources sufficient to meet the demand?

These are the problems which we in the copper business must face, either as producers or consumers, and, as intimated previously, our expertness will be determined by our ability to forecast the future.

January 1, 1917, is unique in the history of copper production. Not a pound of unsold copper existed. This state-

ment applies not only to copper ready for shipment, but to a large extent to copper in transit and in partial stages of treatment. Furthermore, producing capacities were practically sold to 100 per cent capacity for the first six months of 1917, and large orders were ready for later commitments if the producers were able to take care of them.

Electric power and street-railway companies recognize the difficulties attendant on their morning and evening peak loads and, in their parlance, we have a peak load for the entire 24 hours and steady for six months, with prospects of the same condition existing for the last six months of 1917.

The Enormous Consumption of Copper for Ammunition.

Let us look at the situation more in detail: Heavy sales made for export requirements for the first half of 1917, in addition to the abnormal demand for domestic consumption, denuded the market of copper for this period. Some idea of this demand can be obtained by taking one item of copper consumption alone, namely, ammunition. The amount of copper used for this purpose, chiefly as brass, is utterly astounding. Cartridge cases and shells are made from brass containing 70 per cent copper and 30 per cent zinc. The ordinary army cartridge contains 23,000 to 28,000 pounds of copper in a million cartridges, according to the make of the rifle. A three-inch rapid-fire gun uses a cartridge weighing 1 pound 5 ounces, a six-inch gun takes a cartridge weighing 28 pounds 13.5 ounces, and so on, increasing in copper consumption as the size of the gun increases. All shrapnel and high-explosive shells require a copper compression ring, or shell band, to enable the projectile to follow the rifling in the guns; these rings will average from 2.5 pounds upwards in weight. A new type of bullet now being used extensively in Europe is made of brass, containing 90 per cent copper and 10 per cent tin.

The common antimonial lead bullet is encased with a cupro-nickel jacket, usually 85 per cent copper and 15 per cent nickel. It is estimated that before the war 20,000,000 pounds of copper was consumed annually by the ammunition makers in the United States, and that during 1916 this consumption jumped to more than 700,000,000 pounds.

An interesting statement in this connection, and showing the relation between certain materials, is the list of metals covering a specific war order, shown in Table III.

TABLE III—COPPER ENTERING INTO A SINGLE MUNITION ORDER.

Material		Rough Weight Tons		Finished Weight Tons
Steel		141,953		70,977
Brass	30% zinc — 8,145 tons 70% copper—19,635 tons	28,050	4,208.7 9,200.3	14,029
Copper		3,630		1,815
Copper total, including copper in above brass		23,265		11,015.3
Lead, approximate		30,000		18,079
Tin, sheet		300		211
Miscellaneous		.....		10,038

From Table III it is seen that the copper weight is 11 per cent of the total weight of the shells.

The various mills producing sheet, wire and copper products in the United States have a capacity of about 140,000,000 pounds of copper per month, and added to this excessive demand for copper is the export requirements of the Allied Governments, amounting to 60,000,000 to 85,000,000 pounds of raw copper per month. Consequently, as the present 100 per cent producing capacity of the copper industry is about 200,000,000 pounds per month, it can be seen that the present demand is in excess of the supply.

Demands of Railways.

It may be of interest to give some figures as showing to what extent the street railway and electrified steam railroads are users of copper.

The street railways are large copper consumers; the ordinary city electric car will contain from 1,000 to 2,500 pounds of copper, and some of the large interurban cars will have nearly 4,000 pounds. As illustrating the use of copper, I have taken a street-railway system in a city of about 150,000 people; power is supplied from one central-station engine-driven direct-current unit. The copper used is approximately as shown in Table IV.

TABLE IV—COPPER USED IN A TYPICAL STREET-RAILWAY SYSTEM.

	Pounds
Feeder system	2,433,000
Overhead trolley	528,000
Track bonding and special work	225,000
Car equipment	510,000
Power house	46,000
Total	3,742,000
Number of cars operated	550
Total mileage based on single-track miles	176
Capacity of generating stations	6,800 kilowatts
Average copper per mile of track	21,400 pounds

The amounts in Table IV do not include the copper in the store room.

Many electric roads will show a smaller figure, and some in large cities, such as New York, Boston, Chicago and San Francisco will show a higher figure, but even assuming a figure of only 15,000 pounds of copper per mile, and considering that there are approximately 45,000 miles of electric railways in the United States, approximately 675,000,000 pounds of copper is used.

A considerable amount of new copper is used annually to maintain the electrical equipment on electric railways—windings burn out or the insulation is damaged; commutators wear, controllers and circuit-breaker parts become damaged; the trolley wire breaks or partly wears out; all the copper in these parts is sold for scrap and new copper purchased.

Steam Railroad Electrification in the United States.

Several examples only out of many installations are given as illustrating the extensive use of copper by large electrification projects.

TABLE V—NORFOLK & WESTERN RAILWAY—ELKHORN GRADE—BLUEFIELD ELECTRIFICATION.

	Pounds
Transmission	175,000
Distribution, including trolley, feeders, etc.	377,000
Track-bonding	87,000
Ground-plates	55,000
Locomotives	300,000
Transformers	70,000
Generators	56,000
Switchboards, wiring and miscellaneous	25,000
	1,145,000
Total single-track mileage, miles	90
Amount of copper used per mile of track	12,700 pounds

TABLE VI—BUTTE, ANACONDA & PACIFIC RAILWAY.

	Pounds
Substations	29,750
Locomotives	173,700
Distributing system, trolley, feeder cable and track bonds	916,382
	1,119,832
Total single-track mileage, miles	95
Amount of copper used per mile, pounds	11,800

TABLE VII—CHICAGO, MILWAUKEE & ST. PAUL MAIN LINE FROM HARLOWTON, MONT., TO AVERY, IDAHO.

Approximate main line distance, miles	440
Miles electrified, Deer Lodge-Harlowton, single-track basis	321
Copper in substation equipment, locomotives, transmission and distribution systems, pounds	7,550,000
In addition, the signal system will use approximately, pounds	250,000
Additional telephone facilities in connection with this work will require, approximately	110,000
Total copper, pounds	7,910,000
Amount of copper used per mile of track, pounds	24,600

The amount of copper shown in Table VII (7,910,000 pounds), only applies to half of the electrification; that is, Deer Lodge-Harlowton. The complete electrification from Harlowton, Mont., to Avery, Idaho, will use approximately 15,000,000 pounds.

From the above, and considering improvements in the way of voltages, 10,000 to 25,000 pounds of copper per mile

may be considered to be an average minimum figure for future work. If all of the railroads in the United States were electrically operated it would require the world's entire output of copper for two years at the present rate of production, the mileage being approximately 330,000 miles on single-track basis.

In almost every line of endeavor in the business and manufacturing world copper is becoming more and more necessary and the consumption is increasing constantly.

Another factor very seriously influencing and restricting capacities is the transportation difficulties at this time due to extreme congestion between Minnesota and Buffalo; that is, the middle west cities. Copper in transit from mines to refineries on the eastern seaboard takes between 30 and 60 days at present, where heretofore the usual time required was 21 days. In fact, at the present time some of this copper is being routed as an expedient over southern lines, other shipments being sent to Galveston, Texas, and then by water routes to New York harbor. This situation is now very acute and it will take at least a month of continuous good weather to even approach normal conditions.

No Lower Prices in Sight.

With our own government coming into the market for enormous munitions, the domestic and foreign governments inquiring for copper for the second half of 1917—and these are no idle phrases—no recession from present price levels seems possible. Any prospective purchasers of copper, requiring same during the next six months, as wire, sheet or any other manufactured shape, should be concerned not so much about the price but whether or not it will be possible to obtain it at all in the quantities required. Prices will be high certainly, but the pinch will be in making satisfactory deliveries.

Due to the very high prices of copper for many months past, the purchasing of copper wire and cable in many instances has been greatly curtailed because it makes the investment a relatively large one when compared with similar material installed in normal times. The business in power-transmission wire and cable has been very light; the street-railway people have purchased only for their imperative needs. Electric lighting companies have purchased a little more freely than others, which is natural, because of the increased business they have had offered to them from night work in factories, increased use of power for manufacturing purposes, etc.

The absence of the normal amount of wire and cable for hydroelectric plants and street railways has not been a hardship in the wire and cable mills; perhaps it has been a rather welcome relief. There has been such a tremendous demand for copper wire and cable for other uses that, as a matter of fact, the mills have been unable to meet the needs, even by working night shifts. At the present time, in most classes of wire, the mills are asking customers to specify their needs three or four months in advance, and the indications are that these conditions will prevail for some time, and even become more acute.

Just what the future will be is hard to forecast, but it is evident that, considering the conditions which exist now, it would be well to carefully study your wire requirements, and place your orders with the mills in plenty of time to allow for delayed shipments or even longer deliveries.

UNDERGROUND CONSTRUCTION COSTS AT BOSTON.

Discussion of Various Items Entering Into Cost of Street-Lighting Before Massachusetts Commission.

Hearings before the Massachusetts Gas and Electric Light Commission, sitting as a board of arbitration to determine the reasonableness of the Boston Edison Company's rates for street lighting of Boston, have thus far run more than 80 days, having been begun early last spring. About 7,000 typewritten pages of testimony have been taken. Recent sessions have been taken up with the consideration of exhibits and testimony of Professor Harry E. Clifford, of the electrical engineering department of Technology and Harvard University, who is retained by the City of Boston and has made an independent study of investment costs bearing on the lighting service.

At a recent hearing Professor Clifford testified that in his opinion $446,370 was a fair charge for the total investment in conduits, manholes and transmission cables supplying Boston's street-lighting service. The company's figure was $581,600. He held that there were actually 12,000 feet of transmission cables less than the company's exhibit showed. In response, F. M. Ives, counsel for the Boston Edison, pointed out that it had accurate measurements of the lines on the whole system taken since the exhibit was first put in, and they checked within one per cent against earlier figures. On the other hand, the city's representatives had examined only about 35 manholes selected at random, and based its figures on averages. It appeared that the discrepancy resulted from leaving out of account the actual length of racking at the manholes.

A question arose as to what portion of the investment in lines outside the city that are laid to feed back into the city system from suburban substations should be included in the investment account. Commissioner Lewenberg suggested that a tie line connecting a Boston substation and service in the suburban town of Milton might properly be divided between Boston and that town, since it served as an insurance against breakdown to both systems.

Regarding the proper installed price for three-conductor 4-0 cable at the time under discussion, 1914, Professor Clifford reckoned 98 cents per foot as compared with the company's figure of $1.20. It was assumed by the city's expert that the fair price of this type and sized cable over a term of years up to 1914 was 80 cents per foot.

The company's figures showed 85.9 cents as the average price of all cables purchased. Professor Clifford allowed four feet per manhole for waste, as against 10 feet by the company.

Regarding cost of inspection, the company's estimate of 0.6 cent per foot was accepted as a proper charge. The company's figure for drawing in and splicing was 10 cents per foot. Professor Clifford pointed out that a contract with a contracting firm for one job was at the rate of 5.5 cents per foot. This figure was based on a calculation of eight cents per pull for each manhole, 20 manholes to the mile.

The company's figures of 43 cents a foot for wrapping 240 feet of cable per mile, or 12 feet to each manhole, and of 0.5 cent per duct foot for rolling ducts, were not disputed. The figure of $1.29 each for bonding manholes was also accepted.

The Edison Company's figure for high-potential testing was $50 per mile. The city's expert claimed this figure was excessive. He pointed out that the outfit required is a motor truck carrying apparatus for securing the necessary current. Such an outfit was offered to himself for railway testing at $50 per day. He held that a four-mile cable could be tested in half a day, after laying. He believed it to be the right practice to lay the whole length of cable from one terminal to the other before making the test, except in exceptional circumstances. If a cable breaks under test, one can then make a loop test for locating the fault between manholes.

The figure of the company for inspecting and tagging, $1.00 per manhole, was cut in half; Professor Clifford thought the tagging could be done with the splicing and racking.

For terminals in stations, Professor Clifford adopted the company's price, viz., $100 for every two miles of cable. Likewise, for teaming and return freight on reels, the company's figure of $8.25 per reel, 21 lengths and 14 reels per mile.

Watchmen, pumping, cleaning and overtime, were entered by the company at $50 per mile. The city's expert reduced this figure to $25, on the ground that the contractor doing the construction usually supplies watchmen, lights and care.

For incidentals, engineering, etc., for which the company charged 15 per cent, $150 per mile was assumed as fair.

Tendencies in Central-Station Practice

Considerations That Govern the Size and Number of Units and Other Features of Generating-Station Design in Plants of Various Size—Combinations of Plants Into Systems

By J. W. SHUSTER
Assistant Professor of Electrical Engineering, University of Wisconsin

SINCE the central station has come to be such an important factor in the life of the community in which it is located, both as to its service to the locality and as one of the important commercial assets of the city, it is of interest to take an inventory of its present condition and a look toward its future.

As affecting the tendencies in central-station practice there are two factors which probably influence the trend of construction and management more than all others. Namely, the increased cost of fuel and the taking over of plants and combining them into large systems supplied through transmission lines from one or a number of large generating plants.

The central station, if it is to continue to maintain its identity as a local institution, must be alert to take advantage of any available improvement.

It is advantageous in a study of this question to classify the plants into small, moderate, large, and extra large plants.

There can be set no definite dividing line for this classification, but for our purpose we will fix the limits as follows: Small to include all plants under 300 kilowatts capacity; intermediate plants between 300 and 5,000 kilowatts, and large, those plants between 5,000 and 50,000 kilowatts; extra large will include all plants above 50,000 kilowatts capacity.

Number and Size of Units to Give Best Results.

One of the first things to suggest itself in the analysis of a central-station problem is the number and size of units which it should contain in order to meet all requirements to the best advantage.

The most important elements entering into this problem are, the shape of the load curve and the necessity for reserve capacity, to take care of emergency conditions. That is to say, if we had a uniform load curve and were free from breakdown or interruption of service, the most advantageous size of unit to install, from the standpoint of first cost, cost of attendance and operation, floor space and auxiliary euipment, would be one that would carry the total load of the plant.

This is of course a fanciful condition, but it points the way in which our attention should be directed in deciding this question.

Each community furnishes a load curve which may be more or less typical of that community and it is desirable to select units of such sizes that the units in operation will be carrying as nearly as possible their rated load at all times. This would mean the selection of the machines to fit the load curves. It is usually necessary, however, to make allowance for growth of business so that, for instance, a machine purchased to operate alone on the light load would not be outgrown in a few years. There is involved in the general consideration of this question the load-factor of the various kinds of service supplied by the plant and the diversity-factor of these loads.

It is desirable in most cases to establish a single standard of generating equipment in a plant even though a considerable amount of power must be converted before it can be used to supply its particular demand. The advantages of this procedure are, the use of larger and more efficient units and greater possibilities in keeping the units in operation fully loaded, due to better load-factor and only one kind of power being generated. In most cases the total installation can be materially reduced due to the diversity of the various loads and the smaller amount of reserve capacity necessary.

The method of providing reserve capacity to take care of emergencies has usually been:

1. To depend on the overload capacity of the units when one unit is disabled.
2. Providing an extra unit which is put into service when any one of the regular units is disabled.

With the method which has generally prevailed of rating engine-driven units with a liberal overload capacity for a few hours, the first method works satisfactorily. For example, a plant with five units, each of which has an overload rating of 25 per cent, can have one unit taken out of service when all are at full load without placing an excessive load on the remaining units.

It has come to be the practice of all turbine manufacturers with whom the writer is familiar to rate their units on a maximum rating. Under this method of rating it is necessary to use the second method of providing reserve for emergencies.

With the above principles as a guide a satisfactory selection of the number and size of units gives little difficulty in plants of medium and large sizes. In order to keep down the reserve capacity carried, it is desirable to have five or six units in the plant. With five units to carry the load, and one reserve, there is only 17 per cent of the installation held in reserve. If one reserve unit is considered inadequate, which may well be the case, the addition of another one brings the reserve capacity to about 29 per cent of the total installation.

Considerations That Govern in Plants of Different Size.

Small Plants. From an engineering standpoint, there are more difficulties which cannot be given a satisfactory solution in a small plant than in a larger one. This may, to an extent, excuse some of the blunders which are so often met in looking over small plants. One of the more usual mistakes found is the installation of a direct-current system for such a plant. It is the observation of everyone familiar with such plants that it is usually necessary to change over to alternating current in a few years. This means a sacrifice on the plant equipment and the equipment on the premises of the customer, and usually leaves an unsatisfactory distribution system.

Another type of apparatus not infrequently found in small plants is high-frequency single-phase alternators. The installation of these is more indefensible than that of the direct-current systems. Fortunately, the number of these plants is no longer very great, but the writer has had occasion, not long since, to advise the scrapping of such machines. The machines were in excellent condition, but in order to build up a power load and to prevent a greater loss in changing at a later date the equipment had to be scrapped at a large sacrifice to the owners.

The selection of prime movers for a small central station is a very difficult matter, both from the standpoint of number and size of units, and also the determination of the type best suited for this purpose.

On account of the high cost per unit of capacity and the lower operating efficiency, it is manifestly unwise to

subdivide the capacity of the small plant along the lines indicated above for the plant of moderate size. It is the usual practice in plants of this size to install a single unit of sufficient capacity to carry the load and trust to good fortune as far as emergencies are concerned.

With the present cost of fuel and the prospect that it

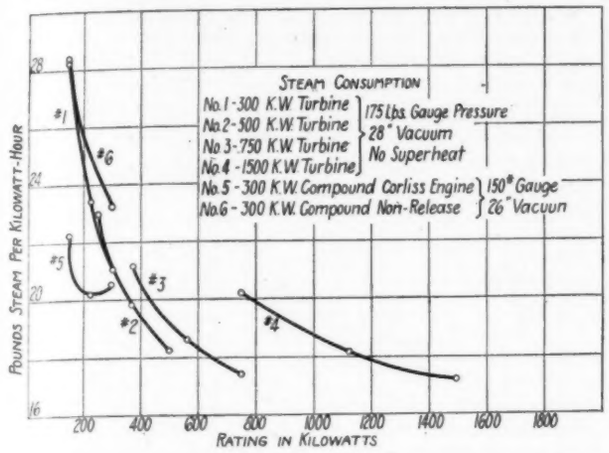


Fig. 1.—Steam Consumption Which May Be Expected from Steam Units of Small and Moderate Sizes.

will not return to its former price even after the conclusion of the controversy at arms which is now affecting it, the greatest care should be exercised to secure the best operating efficiency possible.

In Fig. 1 are given curves which indicate approximately the steam consumption which may be expected from steam units of small and moderate sizes.

Two things are to be particularly noted from these curves: First, the rapid decrease in the full-load efficiency with a decrease in size. Second, the rapid decrease in economy of operation at fractional loads. These facts emphasize the necessity of selecting the largest units feasible and at the same time fitting them to the load curve to secure operation at nearly full load at all times. For the moderate and large sizes of steam plants there is practically no competition with the steam turbine as a prime mover. For the small plant there is more question as to the type of unit best to install.

Comparing curves numbered 1, 5, and 6, it is seen that the slow-speed compound, condensing Corliss engine of 300 kilowatt capacity has a lower steam consumption at full load than the turbine having the same rating and has a still greater advantage at fractional loads. This better economy of the Corliss engine must of course be balanced against a much higher fixed charge than that for the turbine. Which type will be more advantageous will therefore depend on the load-factor of the plant, and the cost of fuel.

Recently, small turbines are being offered which are claimed to give much better fractional-load economy than the standard turbine discussed above. From the limited amount of published data on these machines the Corliss engine appears to retain the lead as far as steam consumption is concerned.

For the very small plants which are operated noncondensing the uniflow engine, which is the latest competitor as a prime mover in the steam plant, has the advantage. Recent tests show a steam consumption of approximately 30 pounds per kilowatt-hour at full load, when operating noncondensing with 140 pounds boiler pressure. These machines give an unusually flat curve, showing a special adaptability to small plants with widely varying loads.

The above examples indicate the interest being taken by manufacturers to provide for the most economical operation of small plants with low load-factors.

While much good work is being done along this line, there remains the fact that many small plants, with peak loads of from 100 to 300 kilowatts have periods of from 6 to 15 hours per day during which time the load is almost a negligible quantity, but for which time there is a demand for service, either due to municipal pride in an "all-day service" or to actual need of a limited amount of power. In going over the records of a small plant of this kind recently, it was found that the steam unit was operated for 18 hours per day and a small oil engine for six hours per day. Under these conditions the load-factor on the steam unit was so low that the average coal consumption was 21.3 pounds per kilowat-hour. This, with coal at $3.50 per ton, gives a fuel cost of 2.14 cents kilowatt-hour.

The oil engine in the same plant operates at fractional load a considerable part of its run. As a result of this its oil consumption is high, being one gallon for each 3.5 kilowatt-hours. With kerosene at 7.5 cents per gallon, the fuel cost per kilowatt-hour is 2.14 cents, the same as above.

That is, the installation of the oil engine provides for holding the fuel cost during the night down to the cost prevailing during the day period.

The above is given, in part, to indicate the difference between the actual operating conditions and guaranteed full-load test conditions. Either of the above units would deliver a kilowatt-hour at full load with a fuel cost of about one-third the amount stated.

Moderate Sized Plants. From curves numbered 2, 3 and 4 in Fig. 1, it is seen that for loads of 500 kilowatts and above a very fair economy can be secured and also that the efficiency from full load to half load improves very materially as the size of unit increases. The selection of units for plants ranging from 300 to 5,000 kilowatts is in a way a compromise between the small and large plants. For instance, a plant with a peak load of 2,500 kilowatts would on the rules laid down above have an installation of six 500-kilowatt units, one being for reserve. It is quite probable that under average conditions it would be more advisable to install three 1,000-kilowatt units (or, if the prospects were for rapid growth, two or three 1,500-kilowatt units). This would be taking more chances as

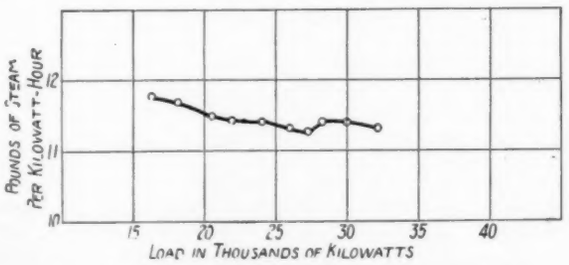


Fig. 2.—Economy of Large Steam Turbo Units.

far as reserve capacity is concerned in order to secure the better economy and lower unit cost of the large units. As the plant grows, additional units of the same size may be added, resulting finally in an ideal layout with uniformity of units.

Large Plants. In plants of 5,000 kilowatts and up to say 50,000 kilowatts the general rules laid down work out admirably and a very satisfactory arrangement can be secured, coupled with moderate cost and economical operation.

Extra Large Plants. What have been classed as extra large plants for this discussion are plants above, say 50,000-kilowatts capacity, though there is no definite dividing line here.

Plants of this order introduce a number of interesting problems which are receiving careful study. It is in these plants that much of the development work along central-

station lines is being carried out. Such a plant introduces the question of limits all along the line, as for example: What is the desirable limit in size of a single plant? Where should the dividing line be drawn between a single plant and a group of plants to supply a given system? What is the maximum size of turbogenerator which should be

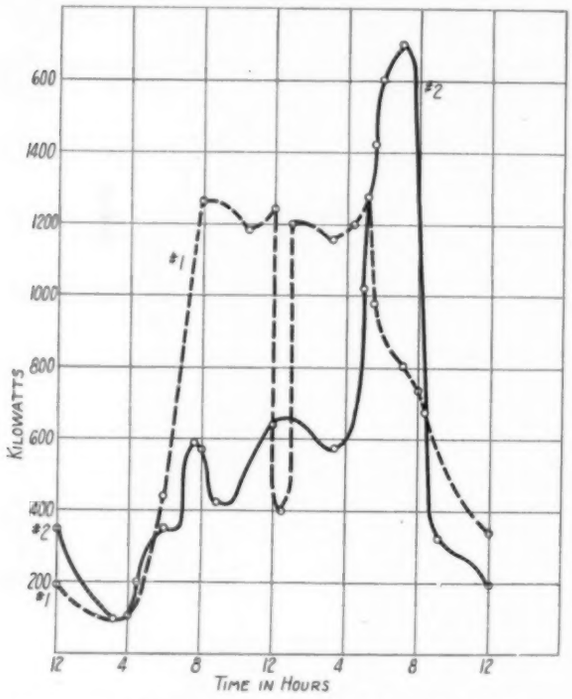


Fig. 3.—Curve Showing Advantages of Diversity in Load.

installed? What is the limit of boiler capacity which should be included in a single unit? What is the limit of boiler pressure which should not be exceeded? To what range of superhead is it desirable to go?

These and various other problems are being considered and determined, for present practice, in connection with the very large plants. It is to be noted, however, with each new development some of the limits suggested are being pushed back farther and farther and there is no definite standard in sight for any of them.

Combination of Plants Into Systems.

As indicated in the introduction, there is a strong tendency in certain quarters to combine the demands for power from a large number of communities into a single system. Several such systems are in existence throughout the country, and their number and importance is growing rapidly.

In some cases the small plants are bought up and held in reserve or dismantled by the larger organization. In others power is sold to the local organization. The sale and the distribution of power is then taken care of by local organizations as before. The advantages which result from such a combination are:

1. Large size of plant and units installed.
2. Lower unit cost of installation.
3. Better economy of operation of the large units.
4. Smaller total installation on account of diversity of load and smaller total reserve.

The marked economy which is being secured from the large turbo units is indicated by the curve in Fig. 2, which is taken from test data of the 30,000-kilowatt turbines of the Interburrough Rapid Transit Company of New York, which were published by the late Henry G. Stott and his associates.

These data, compared with those in Fig. 1, show clearly the saving in dollars and suggest the marked advantages which will accrue in the conservation of our fuel resources.

Fig. 3 is given to illustrate the advantage which can be taken of the diversity of load which is found in comparing the demands of different communities. Curve No. 1 indicates the day load of a plant where the power demand is the predominating one. In curve No. 2, while there is a considerable power demand, the demand for light is the controlling factor on the plant. These two plants taken separately would require, without reserve, installations of 1,300 and 1,700 kilowatts, respectively. If this total demand could be supplied from a single source the corresponding installation would be 2,500 kilowatts, a saving in equipment to carry the combined loads of 500 kilowatts, or a diversity-factor between the two plants of 1.2. There would in all probability be a reduction in the amount of reserve equipment required.

Balanced against these advantages are:

1. The cost of the transmission system and its maintenance.
2. The reliability of the transmission system and the possible requirement of a reserve plant in each locality to be operated in the event of failure of the transmission system.

The importance of the first disadvantage depends on the distances to be covered and the amount of the power demands in each locality. The second question is more difficult to discuss, as it is largely a matter of judgment as to how much emphasis to give it. There is a tendency on the part of certain state commissions to insist on a steam reserve of large capacity being maintained to insure service to cities which are receiving their power over transmission lines from hydroelectric plants. If the same policy is followed in connection with the localities supplied from any interconnected system, many of the advantages claimed for the combined operation would be lost.

The above discussion raises many questions of importance, both as to engineering details and likewise economic policy.

Whatever the attitude of the central-station man may be to the policy of combination, it is evident from the development in this direction within the last few years, that plants in the more populous sections of the country will have to meet the problem and decide it with respect to their own property in the near future.

The greater the care exercised in securing the most economical operation of the existing properties the less will be the necessity of joining up with a large combination.

Texas Power & Light Company Offering Preferred Stock to Employees.

At the first of the year the Texas Power & Light Company, Dallas, Tex., inaugurated a plan which has been contemplated for some time of offering its regular employees an opportunity to subscribe for the preferred stock of the company on an easy-payment plan.

The stock is being offered to individuals in the employ of the company and to the members of the family or household of these inviduals, a limit of 10 shares being placed on any individual subscription.

The stock is being offered at par, the value being $100 per share. Payments may be made at the rate of $5 per month per share of stock subscribed to. Payments may be anticipated if desired by the purchaser. No interest is charged on the deferred payments and dividends are paid the purchaser on the full amount of the stock subscribed for from the time the first payment is made. The stock pays seven per cent annual dividends, the dividends being payable quarterly. The stock is cumulative.

The plan is meeting with ready response on the part of employees and already more than $50,000 worth of stock has been subscribed for.

Tendencies in Central-Station Design

A Brief Commentary on the More Important Aspects of Design for Electric Generating Stations and Distributing Systems —Departure from Standard Practice a Significant Tendency

By W. R. THOMPSON,
Manager, Engineering and Construction, H. M. Byllesby & Company

AN engineer, in addition to being an adept in handling various kinds of mechanical apparatus and contrivances, is required to show still greater ingenuity in the expenditure of money, so as to bring about returns which will interest and maintain the interest of investing capital.

There are two marked influences which today have a distinguishing effect on the design of the physical property of electric utilities. The first and more important effect is the availability of cheap and ample money. The second is a supply of higher grade operators.

Ample and cheap money, which are directly the result of the success of electrical utility enterprises, particularly those having to do with the sale of electric current for power, lighting and other industrial purposes, has resulted in allowing the designs to approach more nearly the ideals of the engineer rather than designs which, in the tentative state of the industry, were decidedly compromises.

The dearth of intelligent operators in the past is illustrated by an expression—common even today—of "Fool-Proof" apparatus. Today we do not consider that fools will operate our apparatus and we can use apparatus which will receive adequate and intelligent attention.

One of the most marked tendencies in the design of generating stations is the adoption of units of large capacity with attendant high economies and reduction in operating labor. The growth of loads has been so enormous, that it is common today in moderate size plants to provide for additional capacity by installing single units having capacity to carry the entire load of the station. The growth of station loads, while more directly influenced by the increased use and application of electric power, has also been brought about by the physical consolidation of separate systems each served by its separate generating station and concentrating the output for the combined system in one large station.

Ample funds have allowed us to install labor-saving devices warranted from an economical point of view, such as coal and ash-handling machinery and various other mechanically operated devices doing away with labor.

AN ENCOURAGING DEVELOPMENT

Ample and cheap money, which are directly the result of the success of electrical utility enterprises, particularly those having to do with the sale of electricity for power, lighting and other industrial purposes, has resulted in allowing the designs to approach more nearly the ideals of the engineer rather than designs which, in the tentative state of the industry, were decidedly compromises.

Recent practice in the design and construction of steam stations, hydroelectric plants, electrical equipment, etc., shows that there is a very marked tendency to break away from "standard practice" and adopt designs not only of apparatus but of their application, from considerations of merit alone. These tendencies are aptly discussed by the author in this article.

Steam Stations.

In steam stations there is a decided tendency to greater economy as witnessed by increasing steam pressures and increasing the degrees of superheat. This is as a result of the introduction of steam turbines to our use. In the same way, the steam turbine has resulted in more elaborate condensing apparatus and refinements in air and vacuum pumps, tending toward the highest possible vacuum.

Boilers today are operated during peak periods of load at 300 per cent or more of rating and normally 200 per cent or more of rating.

The underfeed type of stoker is being used to a greater extent and has enabled us to realize through its great fuel-burning capacity higher boiler outputs; this increased boiler output is attended with fair economy and reduction of smoke.

In order to secure greater steaming capacity of boilers, more attention is paid to cleanliness of boiler tubes as witnessed by the use of soot blowers.

In the interest of economy we pay more attention to securing air-tight boiler settings which, in many instances, take the form of steel casings.

There is a tendency toward the use of self-supporting steel stacks erected directly over the boilers, resulting in cheaper stacks, shorter flue connections and space economy.

The introduction of steam-flow meters on boilers and feed-water measuring devices anticipated the availability of satisfactory and accurate devices from manufacturers; however, accurate devices are now obtained and are being used extensively in boiler and engine rooms. Better piping and valves have allowed the piping systems to be simplified.

Hydroelectric Stations.

There is a tendency to do away with the clear spillway, and reservoir level controlling devices—whether in the form of tainter gates or automatic flash boards —are found more in use. The more nearly constant reservoir level has many advantages, such as limiting the purchase of reservoir land to that which is ordinarily submerged; it secures the advantage of more uniform head on the plant and facilitates the handling of ice forming in the reservoir. This latter consideration is more important where on logging streams logs are imbedded in the ice. With the constant reservoir level, reservoir ice can usually be held until it rots out even though the spring floods occur when ice is present in the reservoir.

The designers of turbines are giving more attention to the study of the effect of draft-tube and scroll-case form. Further work along this line is facilitated by the use of chemical testing methods, which has made possible the tracing of the course of water through the scroll case, the turbine and the draft tube.

The modern tendency, especially for low-head plants, is toward units consisting of the vertical, single-runner, large-capacity turbine with direct-connected generator. This type of setting economizes in space and furnishes greater reliability due to the accessibility of wearing parts for inspection, adjustment, lubrication and repairs.

The inclosed and heated forebay now being widely used in northern climates prevents the interference of ice in operation. The continued use of submerged opening for forebays is justified by eliminating practically all floating material from the racks.

There is a clearer understanding as to economical capacity of installation, resulting in larger generating capacity with relation to stream discharge than was formerly the case. This

practice is particularly profitable where the cost of fuel is high and where high load-factors obtain, allowing a certain capacity to be used a greater number of hours.

Where conditions affecting the choice in the size of units permit, there is a tendency to reduce the number of units in a plant to say three or four rather than have a large number of relatively small size units.

Electrical Equipment.

With the introduction of the steam turbine, with its low reactance, resulting in high short-circuit capacity, attention has been paid to current-limiting devices or at least to providing disrupting switch capacities of much greater capacity than was necessary when reciprocating units were used, short-circuit current capacities being limited by the inductor type machines or controlled by external reactances.

With stations and systems interconnected by means of both overhead and underground lines, more attention has been paid to and tendency is toward selective switching. The full realization of the benefits of selective switching has in the past been hampered through the absence of satisfactory relays.

With the growth in loads there is a decided tendency toward increasing generating, distributing and transmission voltages. In many systems, the 2300-volt delta distribution has been supplanted by 4000/2300 star distribution, and with cheap transformers local distribution of 6600 volts would be even more desirable. Generating voltages up to 13,200 are common. Increased voltages not only result in the saving of line copper but reduce the cost of switching apparatus by reducing the necessary current-capacity of the switches.

Areas in urban communities served by underground distribution are in many cases less than desired by the municipal authorities in the interest of esthetic considerations or safety to firemen. There is a tendency to comply more readily to demands for extensions of underground construction because of the resulting greater reliability of service and the tendency to curb the activity of the pirate competitor.

On transmission lines longer spans are being used than formerly, especially for lines of moderate capacity standard spans with wood poles of 350 feet and upward are quite common even where the most severe conditions in respect to wind and sleet are met.

Pole-type or outdoor-type substations are being used to greater extent, reducing as they do the cost of service, particularly to small communities. Laterals from transmission lines serving small towns are built with iron wire where the strength of the conductor rather than its conductivity is the regulating consideration in its choice.

The tendency is to allow larger factors of safety in insulation not only of apparatus but in transmission-line insulation.

Transmission-line locations are chosen having in mind possible inductive interference with communication circuits quite contrary to practice in the past when information on this subject was considerably more meager than it is today.

Street-lighting systems have a tendency toward the incandescent light placed low rather than high and at frequent intervals.

General Tendencies.

Buildings are of more permanent and safe construction, generally fireproof throughout.

There is a marked movement toward the use of safeguards for the life and limb of operators as well as the public, the tendency probably being guided more by humanitarian impulses than as a result of mandatory laws or purely economic considerations.

In the past, with relatively few capable engineers, there was a decided tendency among those less fortunately equipped, to blindly follow that bogy commonly spoken of as "Standard Practice." Even today we have a regard for standards not entirely merited by the standards themselves.

Having in mind the fact that our engineers have been quite thoroughly disciplined in the standard hobby, it is praiseworthy to note the tendency to break away from this standard habit of practice and thought and adopt designs not only of apparatus but their application from considerations of merit alone.

While the success of our industry, from the investor's point of view, is assured and beyond the experimental stage, yet the physical property of the enterprise, judging from the rapid changes in the past, is an experimental stage, and our engineering practice should not be so bound by precedents as to curb our initiative and inventive tendencies.

How Holding Companies Upbuild Utilities.

The position which the holding company occupies in the utility field is interestingly discussed in a recent circular issued by E. G. Connette, president of the United Gas & Electric Corporation, New York, N. Y., the basis of the discussion being a recent editorial in the New York *American*.

The development of holding companies in recent years has contributed greatly toward upbuilding public utilities throughout the United States.

Their steady efforts to work out a more effective service for public utility companies, to devise better equipment, and to organize more efficient management have won the confidence of the people.

These companies are managed by leaders of the public utility world whose life work has been the expansion and refinement of public service.

To keep in constant touch with their field, they watch each new invention, study every step taken by other holding companies, follow the trend of public opinion in every community where public utilities operate.

Thus do they single out for their subsidiaries the highest developments in public service the country over.

To manage its subsidiaries, the holding company is always searching for the best trained public utility experts.

Chances of advancement not possible with an independent company attract to it men who already have made good in some branch of public service.

An expert whose success has benefited some one community may reasonably expect with a holding company a place where he can devote his abilities to a whole group of operating companies.

The holding company employs at its central office a staff of specialists who devote themselves to the needs of all the subsidiaries.

Thus the company places at the service of its smallest subsidiary recognized experts such as only the largest and wealthiest independent company could afford.

An efficiency otherwise impossible is effected through central managing, accountants and legal departments.

A central purchasing department secures further savings by buying in large quantities standardized equipment for all subsidiaries.

New York Commission to Consider Prevention of Strikes.

Hearings will be held by the Public Service Commission for the First District, New York, to determine whether it is possible to enact a state law which will prevent strikes on street railroads, including rapid-transit lines. The hearing will be undertaken in connection with the consideration of the plan of Chairman Oscar S. Straus for preventing strikes or lockouts upon street railroads, and looking to the payment of fair and reasonable wages to the employees of these lines. The proposal to enact legislation of this sort grows out of the strike situation of last summer at which time there were street-car strikes affecting all the boroughs of Greater New York save Brooklyn. In the hearings, instituted at that time it became apparent that further efforts should be made looking to a constructive effort to prevent recurrence of such a situation.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

Toledo Company Sells 130 Electric Washing Machines In 30-Day Campaign.

The new-business department of the Toledo (O.) Railways & Light Company is breaking all records for any city of its size for selling electric washing machines. At the beginning of the present campaign expectations were to sell a carload of machines, 65 in all, but by February 13, the entire carload has been disposed of and an order for another carload was sent to the Hurley Machine Company of Chicago. The company now expects to sell at least 130 machines. The machines sell for $100 to $175 apiece, but the customer is given a year in which to pay.

Actual washing and ironing of clothes in the display room of the company is being demonstrated. Thor posters have been posted in all the street cars, large display ads carried in the newspapers and letters have been sent out to all prospects. These letters are being sent out at the rate of five a day and immediately followed up with a personal call. It is found to be the most successful way to conduct a mailing campaign yet adapted, according to A. K. Young, new-business manager. The representatives have closed sales with practically three out of every five prospects.

Large Power Loads Added by Boston Company.

Among the new power contracts recently closed by the Edison Electric Illuminating Company, of Boston, are the following:

American Tube Works (added)	1,200	kilowatts
Boston Belting Company	400	horsepower
A. M. Barnes Steam Specialty Company	455	kilowatts
Western Electric Company	612	kilowatts
Mass. General Hospital	325	kilowatts
Tarrant P. King, Trustee	210	kilowatts
A. & J. M. Anderson Manufacturing Company	453	horsepower
Gillette Safety Razor Company	240	horsepower
Draper Bros. Company, Canton	208	horsepower
Panther Rubber Company, Chelsea	240	horsepower
J. L. Thompson Manufacturing Company, Waltham	175	horsepower
Hugh Nawn Contracting Company	199	kilowatts
Union Steel Casting Company	113	kilowatts
Sturtevant Mill Company, Dorchester	215	horsepower
The Stafford Company, Hyde Park	125	horsepower

ELECTRIC LIGHTING ADVERTISED AS A MORAL INFLUENCE.

Series of Advertisements of Louisville Gas & Electric Company Gains Support of Parents.

Among the intangible assets of an electrically lighted home is its wholesomeness. As an aid to proper rearing of children such a home is obviously of great value. Whatever else may be said about a dimly lighted place of abode, it cannot be called cheerful after dark. The expressions, "bright lights" or "white lights" have come to have a sinister meaning they do not deserve. The psychology back of them is that they are provided to bring the people out, in recognition of the necessity of creating an appearance of good cheer.

As is the case with other utility companies which feel it good policy to carry a standing advertisement in their local newspapers, the Louisville (Ky.) Gas & Electric Company, not long ago found that stock talking points were getting pretty low and it was almost a case of working over some old stuff in order to keep going. The copy man had been nurturing an idea about the part that proper lighting could play in bringing up a family. He had been running advertisements in which he had pointed out the convenience of electric light; the cheapness of it; the advantages of having a house wired in the way of being able to use electric irons, electric fans, heating pads for the the sick room, percolators, etc,

He had cited numerous instances of how electric wiring had enabled owners of residence property to rent it or sell it to advantage. He had, in fact, during the last two or three years very completely exhausted the changes on almost all the practical talking points to be urged in favor of electric lighting. In between times he had boosted for various campaign plans, conducted contests etc. There seemed not much left in the way of a tangible advantage to be featured in the way of an advertisement. So he

"Come to My House Tonight, Fred, It's Light and Pleasant There."
Of course you wish your daughter to receive her young men friends at home. You want to know them yourself.
A well-lighted home is inviting; it helps your daughter to be the kind of a girl you like to plan and save for.
Two or three cents a night spent for electric lighting will help you to entertain guests in surroundings so pleasant that they will be glad to call again.
Electric Wiring Costs Less Than a Piece of Furniture. The Partial Payment Plan Makes It Easy. Call Main or City 2182.
LOUISVILLE GAS & ELECTRIC CO.
211 WEST CHESTNUT ST.
Good Lighting Makes Your Home Attractive
THE poorly lighted home cannot compete successfully with the well-lighted places of outside amusement.
Many of these outside amusement sources are desirable. Others are not. But all use plenty of light.
Two or three cents spent for electric lighting in the home every night will help parents solve one of their hardest problems.
If you want your children to use their home and keep them there at night make sure that your house is well and pleasantly illuminated.
Electric Wiring Adds to Property Values. The Partial Payment Plan Makes It Easy. Call Main or City 2182.
LOUISVILLE GAS & ELECTRIC CO.
211 WEST CHESTNUT STREET.
The Modern Guardian of the Happy Home
THERE are few better safeguards against evil influences from the outside than good lighting in the home.
Light in the streets and alleys is the best policeman—so crime experts the world over declare.
Light in the home helps to solve a hard problem for parents by making the home as attractive for the children as any other place.
It is difficult to think of a wiser expenditure of a few cents a day than the small cost of electric service.
Electric Wiring Costs Less Than a Good Suit of Clothes—the Partial Payment Plan Makes It Easy. Call Main or City 2182
LOUISVILLE GAS & ELECTRIC CO.
211 WEST CHESTNUT STREET.
"Electricity Serves and Saves"

Three Advertisements of a Series Published by Louisville Gas & Electric Company Pointing Out Moral Influence of a Well Lighted Home.

What a Few Kilowatt Hours Mean to Your Boys and Girls
ELECTRIC light to will do more to keep your children home in the evening than many stern talks
Many amusements which take the children away from the home at night are desirable—others are not.
Every outside influence which competes with the home for the interest of your children uses plenty of light.
The few cents spent to properly light your home every night will be a great aid toward developing your children into the kind of men and women you want them to become.
Houses Are Wired at Low Prices on Easy Payments! Terms
Call Main or City 2182
LOUISVILLE GAS & ELECTRIC Co.
311 WEST CHESTNUT ST
"The Safe, Sane, Silent Servant—Electricity"
"Tonight—At My House We'll Learn All About Wireless"
TWO or three cents worth of electricity a night is the best investment a mother ever made to fight the "gang."
Some outside amusements which take boys away from home at night are good for them; others are not. But every one uses plenty of light.
Cheerful, well-lighted homes help a boy to become interested in books; in mechanics; in studying things which are beneficial to him.
Good lighting makes it easy for a boy to invite his friends in to spend the evening with him. It keeps him and his friends off the street.
Electric Wiring Costs Less Than a New Rug. The Partial-Payment Plan Makes It Easy. Call Main or City 2182.
LOUISVILLE GAS & ELECTRIC CO.
INCORPORATED
311 WEST CHESTNUT ST.
"Electricity Saves and Sanes"
This Family Is Happy All Evening In Their Well-Lighted Home
OUTSIDE DISTRACTIONS are not nearly so tempting as the real pleasure of a cozy home in the evening.
Cheerful surroundings after nightfall are impossible without good lighting.
No one likes to spend the evening in a dark, gloomy household. Life and brightness are necessary for contentment.
Many a home has been made happy by spending two or three cents a day for electric service.
The Partial Payment Plan Makes House Wiring Easy to Obtain. Call Main or City 2182.
LOUISVILLE GAS & ELECTRIC CO.
INCORPORATED
311 WEST CHESTNUT ST.
"An Electric Wire Makes the Home of Desire."

In These Advertisements the Louisville Gas & Electric Company Graphically Portrays Influence of Well Lighted Homes on Children.

went to work on elaboration of his idea about the moral influences of electric light in the home.

The principle was carried out in a series of six advertisements, each of them presenting the same basic idea and all of them addressed to the parents and guardians of the young people, to the heads of the houses which are not now wired or not properly wired and lighted. For each an appropriate drawing was provided, the first showing a boy and girl welcoming a friend, and underneath the caption: "What a Few Kilowatt-Hours Mean to Your Boys and Girls." The second shows a happy family scene and the idea: "This Family Is Happy All Evening in Their Well-Lighted Home." The third pictures one lad inviting others to his home that evening to "Learn All About Wireless." In the fourth picture the young lady is inviting her beau to her home: "It's Light and Pleasant There." Another advertisement gives a glimpse of a home dance with young folks having their wholesome pleasure in the light, and the final advertisement sums up the whole by describing the electric lamp as "The Modern Guardian of the Happy Home."

Throughout the series the theme was that you cannot keep children and young folks at home in the evenings unless you make the homes cheerful, and you cannot make them cheerful without electric lighting. The argument was that to rear your children to be the kind of men and women you want them to be they must have the influence of a good and cheerful home. The idea was presented from several different angles to make its appeal to individuals whose situation happened to be that illustrated in each separate piece of copy and in each advertisement the impulse created by the presentation of the case was followed up with a statement of how easily conditions not as they ought to be could be made what they should be to gain the ends desired.

There were numerous striking and epigramatic sentences in the various advertisements.

The series of advertisements was divided up among the four English dailies in Louisville, one advertisement being used each week beginning early in January and running to the middle of February. They attracted a great deal of attention and there was a large amount of comment. Some thoughtful people wrote letters to the Louisville Gas & Electric Company, complimenting it on the tone and character of the advertising being used. It was reported that several ministers mentioned the same thought in their sermons.

There is no getting away from the contentions expressed in this series. The statements made are obviously true. Of course electric light alone will not make the home cheerful or an inviting place but on the other hand the fact remains that good lights are essential to good homes. Again when the advertiser lines up on the side of good morals he gains a tremendous advantage—that of the backing of an undoubtedly large majority of people. It is not expressed or apparent, perhaps—this support—but it is none the less real and valuable. Most people are morally sound and a moral argument is going to gain their approval at the outset, whether its practical application is specially definite and practical, or not.

Port Huron Company Renews Street-Lighting Contract With the City.

A proposition recently submitted by the Port Huron Gas & Electric Company to the city of Port Huron, Mich., makes a rate of $60 per lamp per year for the present installation of series arcs now in use in the city. This is on the basis of either a five, seven or ten-year contract. The price quoted would be about $1,500 per year less than the former contract which expired January 1. The company also made a proposition for a five-year contract for the installation of what is termed type "C" series incandescent nitrogen lamps as follows: 600 candlepower, $60 per year per lamp; 400 candlepower, $48 per year; 100 candlepower, $20 per year. On the basis of a seven-year contract for said type the proposition made is: 600 candlepower, $55 per year; 400 candlepower, $44 per year; 100 candlepower, $20 per year.

The company further proposes that on either the five or seven-year contracts, the prices above named shall include all maintenance, repairs and renewals. The city shall have the right to install lamps in addition to the 277 now contracted for and at the same rates as above stated. In the event that type "C" is adopted the 600 and 400 candlepower lamps shall be equipped with Novalux pendants and prismatic reflector-refractors; 100 candlepower lamps will be equipped with radial wave reflectors. At present the system of lights being operated for the city comprises 152 of the 600 candlepower lamps; 89 of the 400 candlepower lamps and 36 of the 100 candlepower lamps.

APPLIANCE DEPARTMENTS SHOULD BE CONDUCTED AT PROFIT.

New England Central-Station Men Discuss Merchandising On Visit to Providence Company.

An occasion unique in the history of the New England Section, N. E. L. A., was the visit of observation with the Narragansett Electric Lighting Company, Providence, R. I., on February 15. Central-station men from various parts of the territory went to the Rhode Island city, a company of about 60 going by special car from Boston, while others were present from Worcester and other cities. After inspecting the company's electric shop, and exchanging greetings with company officials at their offices in the Turk's Head Building, the party repaired to the New Crown Hotel for luncheon and post-prandial speaking.

A. B. Lisle, general manager of the Narragansett company, welcomed the guests and introduced E. R. Davenport, sales manager, as toastmaster.

Mr. Davenport described the company's policy with respect to its electric shop, which is conducted at a profit, that of 1916 being $6,500, after paying rent, advertising, help and all incidental expenses. The company recently conducted an electric-sign campaign with manufacturers' co-operation, securing business with no outlay by the company. The sale of motors last year yielded profit sufficient to pay the salaries of the power engineers. The lighting department's sales in connection with house-wiring campaigns had covered about one-third of the expense involved in securing the business, and the merchandising department was about two-thirds self-sustaining.

R. S. Hale, chairman of the Wiring Committee, N. E. L. A., spoke of the efforts now being made to standardize plugs and receptacles. He held that attachment plugs should be standardized, both as to the attachment end and the cord. Five years ago there was a great variety of plugs; now there are practically two, and the committee is working for the adoption of a single type. Manufacturers are to be called in conference about March 15. The committee's policy is not to attempt to force matters, but to appeal to the manufacturers' self interest to bring about the result so greatly desired by large purchasers of appliances and the National Electric Light Association generally.

Mr. Davenport expressed the belief that the result would be accomplished more speedily if central-station purchasers were to prescribe that attachments on goods they order should be standard.

A. H. Allcott, in charge of the company's four electric shops, held that a central-station's appliance business should be self-supporting, like any other merchandising enterprise. The Providence Electric Shop was opened in 1913. In 1914 and 1915 the cost of fitting up the store rendered the showing of a profit impossible. In 1916 the store was doubled in size; despite the cost, which was borne by earnings, the department yielded a dividend, as noted above. One feature of economical purchasing is to place orders for appliances well in advance, so manufacturers may make up the goods in dull seasons. Special sales are planned for each month up to July next.

Portable lamps have been a feature of the electric shop business. Last year 1,400 were sold.

The show window comes in for much careful attention, a change of setting being made weekly or oftener. The aim is to have a central theme that presents a real appeal, rather than cater to mere curiosity.

The Narragansett company handles the repair problem to good advantage. A repair department is maintained in the basement of the Electric Shop, and one man handles the whole volume of business. Usually repaired appliances are returned within 24 hours. Customers are charged for repairs necessitated by ordinary wear and tear, making no objection thereto.

A feature of appliance advertising is the use of a motion-picture machine, which projects views on the show windows of the appliance stores.

The company's business thus far in 1917 shows an increase of 168 per cent over that of the same period of 1916. The goal this year is a volume of sales amounting to $200,000. Last year they amounted to $150,000.

C. E. Greenwood, superintendent of the appliance department of the Boston Edison Company, pointed out that the public in that city is accustomed to expect free repairs. This is the company's policy with respect to irons, and other appliances.

Franklin Hall, auditor of the Narragansett company, described the methods used to keep the management and various departments informed of the condition of business. About the tenth of each month the president is supplied with a statement of income and expense, and a summary of two, three and five months' business, beginning with the first of the year. Also a skeleton summary for the 12 months ended the last of the month preceding the report.

Mr. Gibson, of the sales department, outlined a plan by which electric-sign business was secured aggregating 48 kilowatts load, with a guarantee of five hours' lighting each night. Purchasers are allowed to pay in installments covering a year. The manufacturers supply salesmen.

C. W. Halstead, sales manager of the Lowell (Mass.) Electric Light Corporation; R. W. Rollins, manager of the Worcester Electric Light Company, and F. A. Gallagher, head of the lighting department of the Providence company, responded to introductions.

Canton (Ill.) Central Station to Furnish Service to Coal Mine.

A contract has been closed between the Canton (Ill.) Gas & Electric Company and the Big Creek Coal Company, of Chicago, to supply power to the latter's coal mine located at St. David, Ill., a distance of about five miles southwest of Canton. Installations will include about 500 horsepower in motors of various sizes, and will operate all the machinery used in the operation of the coal company's mine.

The coal company is now generating its own power by the use of steam engines, and all of this equipment will be replaced by electrically driven apparatus operating on purchased power from the Canton company.

It will require four to six months to secure the apparatus, but it is expected that the coal company will be ready for service by August 1.

It might be interesting to know that the Big Creek Coal Company's mine is not of the ordinary type of hoist, or shaft, mine, but is known as an inclined mine, and is so constructed that coal is delivered directly from a side hill to the ground level, and is then carried to the tipple on an endless chain incline. The capacity of this mine is about 1,500 tons per day.

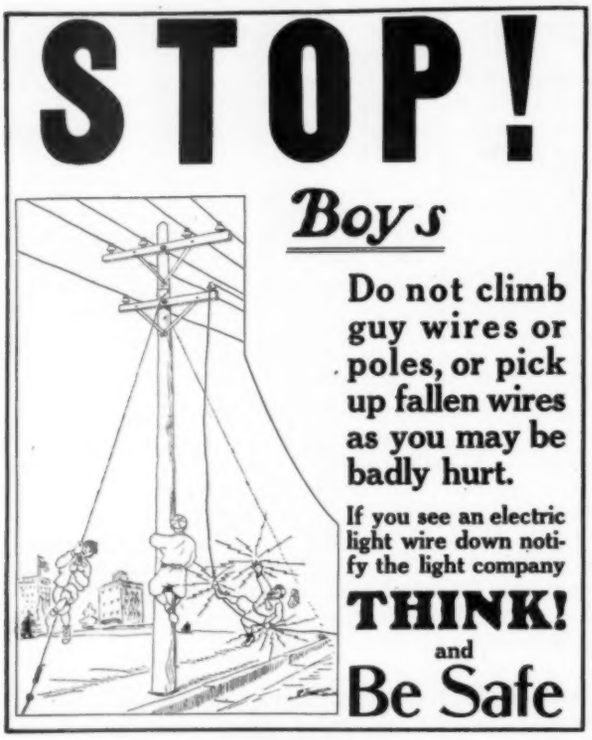
Power for the above mine will be supplied from the electric company's 13,000-volt transmission line now extending through St. David, and the installation will require 450 kilovolt-amperes in step-down transformers.

Washing-Machine Campaign in Boston.

The Edison Electric Illuminating Company of Boston is conducting a washing-machine campaign featuring the Gainaday washer-wringer, which the company is selling at its 15 stores on the instalment plan. Attractive advertisements occupying 15 inches, four columns, are run on Mondays, the traditional wash day.

Texas Company Prosecutes Safety Work in Public Schools.

The Central Safety Committee of the Texas Power & Light Company, Dallas, Tex., has succeeded in interesting the public school authorities in safety to such an extent that the latter have permitted bulletin boards to be placed


STOP!
Boys
Do not climb guy wires or poles, or pick up fallen wires as you may be badly hurt.
If you see an electric light wire down notify the light company
THINK!
and
Be Safe

Poster Which Texas Power & Light Company Is Using in Campaign to Educate School Children.

in the various schools. The accompanying illustration shows one of the special bulletins which this company has recently issued for use among the public-school children.

Practically all of the work undertaken in this connection will be of an educational nature, as the bulletins used will be designed with a view of preventing accidents which are most common in this section.

Denver Theater Erecting Largest Electric Sign in the West.

What is believed the largest electric sign in the West is being erected on the roof of the American Theater of Denver. It measures 52 feet high, 60 feet wide, weighs 15 tons and will have 2,300 lamps totaling 30,000 candlepower, carrying the advertisement of the theater.

Another sign measuring 50 feet wide and 10 feet high, requiring 1,200 lamps of 40,000 candlepower has already been placed in position, and faces a different street. This sign will advertise Vitagraph films, reserving a space for the advertising purposes of the theater.

The American theater, which was opened recently, is said to be the finest in Denver and a triumph for electricity from central-station sources. At the time the theater was under construction the builders contemplated an isolated plant, but this thought was allayed through the salesmanship of the new-business department of the Denver Gas & Electric Company.

The theater embodies the latest in electric lighting effects, as well as having a choralcello, operated by electricity. A total installation of 75 horsepower is used for ventilation, operation of motion-picture machines, etc.

NUMBER OF ELECTRICS INCREASING IN NEW YORK.

Garage of Electric Vehicle Association a Big Factor in Progress.

That the electric automobile is advancing by leaps and bounds in the good graces of New Yorkers is amply verified by the busy and progressive state of affairs at the Electric Garage, Central Park West and 62nd Street, operated under the auspices of the New York Electric Vehicle Association. This garage, which is now rounding out its second year of work, is the headquarters of electric passenger-car owners in Manhattan. It is not only the largest garage in the country and the only one in New York City given over entirely to electric passenger vehicles but is known as the finest one of its kind and has been patterned after by several cities.

The Electric Garage is the outcome of co-operation on the part of the car owners themselves, the Anderson Electric Car Company manufacturers of the Detroit Electric; the Baker, R. & L. Company, manufacturers of the Baker and Rauch & Lang cars, and the New York Edison Company. The Detroit and the Baker, R. & L. companies have their display rooms and general offices in the garage, with spacious show windows on Central Park West.

Walter Neumuller, vice-president and general manager of the garage and treasurer of the New York Electric Vehicle Association, in speaking of the progress made during the last year at the garage said, "Back in February, 1915, when we opened the electric garage there were those who were skeptical as to the probability of an electric garage succeeding in New York City on so large a scale. We started with 77 cars and we are now getting along toward twice that number, with room for only a few more left. The doubting ones also said that we could not do what we set out to do, namely, supply all the energy customers wished to use and care for cars, including washing, polishing, battery inspection, oiling and tire inflation for a flat rate of $40 per month for each car. With what satisfaction we have accomplished this can be best judged by consulting those who keep their cars here. During the year 1916, we used nearly 300,000 kilowatt-hours for charging purposes and made more than 30,000 deliveries and calls for cars. The increasing popularity of the electric vehicle in New York City is also shown by the fact that the dealers located with us report an increased number of sales during the year of 1916."

Arthur Williams, general commercial manager of the New York Edison Company, is the president of the New York Electric Garage and also of the New York Electric Vehicle Association, and takes an active interest in the affairs of both organizations. Another activity of the New York Electric Vehicle Association is the publication annually of a handbook showing the locations of all electric automobile charging stations in New York City and vicinity, together with route maps. This little booklet has just been published and the new edition promises to hold its place of general advisor and first aid to the tourist. It will be sent free to any one requesting it. The 1917 edition has several features—information as to the maximum amperage and voltage available at different charging stations; the hours service may be obtained and prices charged for boosting. Besides this there are clear, concise instructions as to boosting and the possibilities it gives to obtain additional mileage in short order.

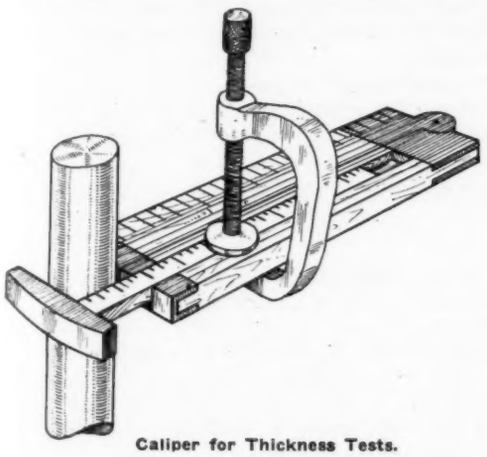
The maps in the pamphlet show a tremendous increase in the number of charging stations recently established within the 100 miles centering around New York City, and an increase also in the facilities of the stations already in existence to meet the constantly greater demands upon them. New York City's map, including the Bronx, is dotted with the little red squares that mean charging stations, while many of them are also fitted for garage service for the electric.

ELECTRICAL CONSTRUCTION

A Department Devoted to Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

Simple Caliper Gauge for Repeated Thickness Tests.

Where there are many rods or wires which are to selected to have a certain diameter, or where there are a number of pieces of work required to be turned out all of the same diameter or thickness, a caliper may be easily made, if



Caliper for Thickness Tests.

none is at hand, by using a small six-inch caliper rule, adjusting the slide to the proper distance and clamping firmly by means of a small machinist's clamp. Both the caliper rule and the clamp may usually be found in the cheap hardware stores and should be on the tool list of every switchboard or panelboard contractor. This caliper and clamp method makes a practical gauge for testing the size of many kinds of work. It is a time and labor saver.

Uses for Soap as a Lubricant by the Electrician.

By Harry B. Stillman.

One of the most useful all-around articles in switchboard or panelboard construction is a bar of the ordinary yellow laundry soap. This makes an excellent lubricant when drilling copper, brass, asbestos, hard rubber or fiber. Touching the drill occasionally with a little soap will help the drill to cut quicker and cleaner, and will usually prevent the drill from sticking or binding, which very often happens when drilling copper or brass. There is also less danger of the drill overheating when a little soap is used.

In tapping or threading copper and brass, soap should be used freely. This aids the tap in cutting a full thread, with less possibility of breaking the tap or stripping the thread. In the experience of many soap has been found to be a far better lubricant than oil in tapping, as oil has a tendency to clog up the channels of the tap with chips. This clogging is apt to tear or strip the thread.

Wood screws for cabinet work, or for panel trims or mats can be screwed in much easier if the screw is first touched to a little soap before starting in the wood.

For particular soldering jobs a little soap rubbed around the spots where a soldered joint is to be made will prevent the solder from spreading around to parts where it is not wanted.

PROPOSED NEW RULES ON GROUNDING.

Recommendations of the Committee on Grounding for New Requirements as to Grounding in the National Electrical Code.

In the summary published last week of changes proposed in the National Electrical Code by the Electrical Committee of the National Fire Protection Association and its subcommittees, brief reference was made to a new rule recommended by the Committee on Grounding. In general, this committee recommended a revision of the present Rule 15 on grounding of low-potential circuits as given below, this rule specifying when grounding will be required for such circuits. The new rule proposed, to be known as 15A, is to cover methods of grounding. It is recommended that it be classed under the rules of "Class C. Inside Work." These revised and new rules would be as follows:

Rule 15. Grounding of Low-Potential Circuits.

Section a. General Provisions.

Where low-potential circuits are grounded under the following rules, circuits must be so arranged that under normal conditions of service there will be no appreciable passage of current over the ground conductor.

Section b. Direct-Current Distribution Systems.

Three-wire direct-current systems (except circuits entirely unexposed to leakage or induction through overhead construction from overhead circuits above 550 volts) must be grounded as provided in Rule 15A.

Two-wire direct-current systems may be grounded and, if grounded, must comply with the requirements of Rule 15A.

Section c. Alternating-Current Distribution Systems.

All secondary distribution systems (except circuits entirely unexposed to leakage or induction through overhead construction from overhead circuits above 550 volts or through transformer or other devices) must be grounded, provided the maximum difference of potential between the grounded point and any other point in the circuit does not exceed 150 volts, and may be grounded when the potential exceeds 150 volts.

15A. Method of Grounding, When Protective Grounding is Required.

(What to ground see Nos. 1*c*, 1*d*, 5*c*, 7*a*, 8*a*, 11*b*, 12*f*, *h*, 15*a*, *b*, *c*, 23*d*, 25*e*, 27*c*, 29*d*, 43*e*, 45*c*, 86*a*.)

Direct-Current Systems.

Section a. In three-wire direct-current system the ground connection must be made on the neutral and at one or more supply stations, but not at individual services or within buildings served.

Section b. In two-wire direct-current systems the ground connection shall be at one station only.

Alternating-Current Systems.

Section c. The ground connection for alternating-current systems shall be made at the building service or near the transformer (or transformers) either by direct ground connection, through water piping system or artificial ground, or by the use of a system ground wire to which are connected the grounded conductors of many secondary mains and which itself is effectually grounded at intervals that will fulfill, for any secondary utilizing the system ground wire, the resistance and current-carrying requirements for Ground Conductors, Section *j*, and Ground Connection, Section *r*.

Where the secondaries of transformers are supplying a common set of mains, fuses shall be installed only at such points as will not cause the loss of the ground connections after the fuses in the transformer circuits or mains have been blown. Multiple grounds are preferable in most cases, but grounds, other than the single ground connection at the building service, shall not be made to alternating-current secondaries within the building served.

Section d. In single-phase, three-wire systems, the ground must be on the neutral conductor.

Section e. In single-phase, two-wire systems, the ground may be on either of the conductors.

Section f. In two-wire single-phase, and in two or three-phase systems, the ground shall be connected at that point of the system which brings about the lowest voltage from ground of unguarded current-carrying parts of connected devices and also permits of most convenient grounding. Where any phase of a two or three-phase systems is used for lighting, that phase should be grounded and at the neutral conductor, if one is used.

Section g. For lightning arresters, the ground connection shall be at such a point that its ground conductor is as short and straight as practicable.

Section h. For generators, motors, transformers, conduit, armored cable, metal molding, etc., the point at which the ground conductor is attached shall, if practicable, be readily accessible.

Gound Conductors.

Section i. In all cases, the ground conductor shall be of copper or of other metal which will not corrode excessively under the existing conditions. The insulation of the ground conductor shall comply with all the requirements of the Code for wires of the voltage of the circuit to which the ground conductor is attached and shall have an identifying covering. In all cases the ground conductor must be protected against mechanical injury. Protection for lightning-arrester ground conductors must be of nonmagnetic material, unless the ground conductor is electrically connected to both ends of the protective device. In no case shall an automatic cutout be inserted in a ground conductor or connection.

Section j. The ground conductors shall, in general, have current capacity sufficient to insure the continuity of the ground connection under conditions of excess current caused by accidental grounding of any normally ungrounded conductor of the circuit.

The ground conductor for a three-wire direct-current system shall not be smaller than the neutral wire to which it is attached.

The ground conductor for three-phase systems must not be smaller than one-fifth the size of the wire to which it is attached, nor smaller than No. 6 B. & S. gauge copper wire, and need not be larger than No. 0 B. & S. gauge copper wire.

No individual ground conductor for alternating-current system shall have less current capacity than that of a No. 6 B. & S. gauge copper wire, except that for additional grounds after the first on any circuit, smaller ground wires may be used, provided that they are in no case smaller than the conductor to which they are attached nor smaller than No. 10 B. & S. gauge copper wire.

Section k. For lightning arresters, the ground conductor shall have a current capacity sufficient to insure the continuity of the ground connection under conditions of excess current caused by or following discharge of arrester.

No individual ground conductor shall have a smaller current capacity than No. 6 B. & S. gauge copper wire.

Section l. For electrical equipment, the ground conductor shall not be less than that provided by copper wire of the size indicated in the following table:

0 to 15 amperes	No. 14 B. & S. gauge
16 to 100 "	No. 10 " "
101 to 200 "	No. 6 " "
201 to 500 "	No. 4 " "

Where the grounded conductor of a circuit has sufficient capacity to satisfy the above table, it may be utilized for grounding electrical equipment, which is otherwise normally effectively insulated from ground.

Section m. If an armored-cable system, a conduit system or a metal-molding system, consists of several separate sections, the sections must be bonded to each other, and the system grounded, or each section may be separately grounded.

The armor of cables, conduits, metal moldings and gas pipes must be securely fastened in outlet boxes, junction boxes and cabinets, so as to secure good electrical connection.

Isolated lengths of armored cable, conduit or metal molding not exceeding 10 feet in length need not be grounded.

Metal cabinets, metal cutout boxes, metal-covered autostarters, and similar devices not used with armored cable, conduit, or metal-molding systems need not be grounded.

Ground wires must be of copper or other metal which will not corrode excessively under the existing conditions. They must be at least equivalent to No. 10 B. & S. gauge copper (where largest wire contained is not greater than No. 0 B. & S. gauge) and need not be greater than No. 4 B. & S. gauge (where the largest wire contained is not greater than No. 0 B. & S. gauge).

Ground Connection.

Section n. The ground connection must be permanent and effective and be made as indicated below but always to water piping system, if available.

The protective grounding of electrical circuits and equipment to water piping systems, in accordance with these rules, should always be permitted, since such grounding offers the most efficient protection to life and property and is not injurious to the piping systems.

For circuits, equipment and arresters at supply stations, connections must be made to all available active, continuous, metallic underground water piping systems between which no appreciable difference of potential normally exists and to one such system if appreciable differences of potential do exist between them. At other places connection must be made to at least one such system if available. Gas piping shall be avoided wherever practicable.

Where underground metallic piping systems are not available, other methods which will secure the desired permanence and conductance may be permitted.

Section o. Protective ground connections for other than electric-railway lightning arresters must not be made to railway negative return circuits when other effective means of grounding are available.

Section p. Ground connections to metallic piping system must be made on the street side of water meters, but connections may be made immediately inside building walls to secure accessibility for inspection and test. When water meters are located outside buildings or in concrete pits within buildings where piping connections are imbedded in concrete flooring, the ground connection may be made on the building side of the meters, if they are suitably shunted.

When the making of a ground to a piping system outside meter or other device would involve a long run, connection may be made to the water piping system at a point near the part to be protected, provided there are no insulating joints in the pipe to prevent a good ground. In such cases care should be taken to electrically connect all parts of the piping system liable to create a hazard and to shunt the pipe system where necessary around meters, etc., in order to keep the connection with the underground piping system continuous.

Gas piping systems within buildings should not be used for purposes of this rule, except that gas piping need not be insulated from otherwise well-grounded electrical fixtures and where the making of another ground connection for a fixture would involve a long run and the fixture is therefore, of course, not within reach of plumbing or plumbing fixtures, the gas piping may for small fixtures be utilized as the sole ground connection. Where gas piping is so used it must be bonded to the water piping systems within the building at their points of entrance.

Section q. The ground connection to metallic piping systems must be made by means of an approved clamp which is bolted

to the pipe after all rust and scale have been removed, or by means of a brass plug tightly screwed into pipe or fitting, or by other equivalent means.

The ground wire must be attached to the clamp or to the plug by means of solder or by an approved solderless connector.

The point of connection should preferably be in plain sight and as readily accessible as possible.

Section r. Artificial grounds should be located where practicable below permanent moisture level. Each ground must present not less than four square feet surface to exterior soil. Areas where ground water level is close to the surface should be used when available.

The combined resistances of the ground wires and connections of any grounded circuit, equipment, or lightning arrester should not exceed 25 ohms.

When ground plates are used they should be at least No. 16 Stubbs gauge copper; when driven pipes are used they should be of galvanized iron and not smaller than one inch internal diameter; and when cast-iron plates are used they should be at least one-quarter inch in thickness.

Proposed Identifying of Neutral Wires.

The committee, among other things, also recommends that Rule 26*a* be amended to require that, after July 1, 1917: "The neutral conductor on all three-wire circuits and one conductor on all two-wire circuits must have an identifying insulating covering, readily distinguishing it from other wires. This wire must be run without transposition throughout the entire installation. When one of the circuit wires is to be grounded, connection shall be made to this identified wire and as prescribed in Rules 15 and 15A."

This agrees with the requirements in the middle of the proposed rule 15A*i*, as given above, and is for the purpose of eliminating the possibility of life or accident hazard from any accidental or careless transposition of the grounded and ungrounded wires which might make fixture casings "live."

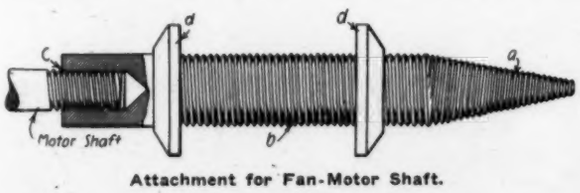
The committee further recommends that as soon as practicable the rules be further revised with the idea that grounding may be extended to all utilization devices, including sockets, fixtures, receptacles and even portable devices. That all of these devices be so made in the future that the casing, shell or covering may be grounded when used with polarized (i. e., identified) circuits. That manufacturers, jobbers, contractors and all interested be asked to co-operate in securing the above results with as little delay as possible.

The committee also suggests that ground clamps be made only of copper and not less than one-sixteenth inch in thickness; that no iron or steel be used in any part of the clamp, except that a steel clamping bolt may be used; that the lug to which the wire is soldered or fastened by an approved connection, be an integral part of the clamp.

Electric Fan Motor as a Small Grinding and Polishing Motor.

By Harry Metalf.

A 10 or 12-inch fan motor with the guard and blades removed and a few changes makes a very handy grinding and polishing motor for the shop. If the shaft extends an inch



Attachment for Fan-Motor Shaft.

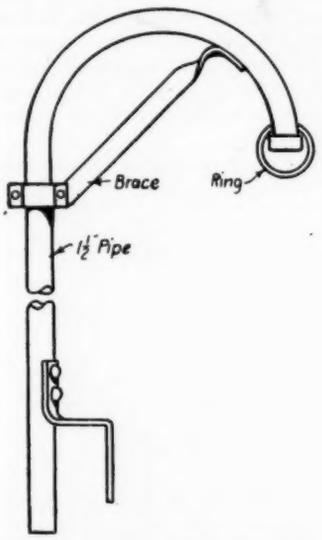
or more, it may be threaded to receive a small wheel buffer or scratch brush. In case of the later types of fans the shaft only extends about one-half inch and it becomes necessary to do a little work on same.

The shaft is threaded as shown and part *b* made of steel or brass, which can best be done in a lathe. If a lathe is not at hand, it can be drilled and tapped by hand at *c* and screwed on the motor shaft and then trued up with a file on a rest while the motor is running at low speed. It is then threaded at *b* after it is true. Part *a* is for buffers, but buffers may be drilled out and put on at *b* which is for emery wheels; *d* and *d'* are nuts which are trued up after putting them in place. This makes a very useful combination.

Pipe Gin for Use in Mounting Transformers.

By U. R. Wilson.

A gin pole made of 1.5-inch pipe curved at the top to form a gooseneck has been found to be a great help in handling



Gin Pole for Mounting Transformers.

transformers. By placing the gin so that the gooseneck projects over the top cross-arm and the bottom end of the gin rests on the lower cross-arm below, it is easy by means of a rope passed through the ring at the gooseneck end to place the blocks directly over the transformer, which is a great aid in hanging the transformer in the desired position. I have used this device on many occasions and always found it helpful.

Refinishing Old Switch Plates.

By Harry Metcalf.

Old switch plates which have become tarnished or scratched up may easily be refinished as follows. This is an important item now as the price of plates is almost "out of sight" at present and nearly every contractor has a stock of damaged ones that he does not like to put into use in their poor condition.

The first operation is to polish the holes for the buttons by using No. 00 or No. 000 sand paper or emery cloth. Next the edges are polished with a piece of the paper on a block, always rubbing parallel with the bevel and in the same direction. Next go over the surface lengthwise with the plate until polished, always moving in the same direction which gives the plate a slightly grained appearance. Never give sand paper a rotary motion.

After polishing as above, give the plate a coat of orange shellac thinned with alcohol by applying with a small piece of cheese cloth and allow to dry. If care has been taken the plate looks as good as new and can be used as good as a new one, if well shellaced or lacquered. Polishing as above is the work of only a few minutes and one profits well for the time spent.

Police Signal System for Large Cities

Description of the Gamewell Police Patrol Signaling System, Particularly the Patrol Boxes, Central-Office Apparatus, Flashlight Call and Scheme of Wiring

By GEORGE A. BRODER

MUNICIPAL police patrol signal systems are as necessary to the efficiency of the police department and the protection of citizens of any community as fire-alarm systems or any apparatus that protects life and property and benefits the public generally. In the modern system by means of signal boxes, located at important street corners throughout the city and connected by arteries of wires to the police headquarters, the police officers make regular reports and send in emergency calls, and in case of necessity responsible citizens may summon police assistance from headquarters.

Development of the System.

The City of Chicago, in 1880, installed the first police signal system in this country, which was designed on the same general principles as the then successful fire-alarm system, being a natural outgrowth of it. It was installed by the late John P. Barrett, for many years superintendent of fire-alarm telegraph for the city and afterward city electrician.

The development of the telephone about this time permitted combining it with the telegraph for this purpose, consequently the system made rapid strides owing to the two separate and definite means of communication afforded. Many useful inventions and improved systems followed.

The original Chicago system was installed in the section of the city most in need of prompt police protection and proved such a success that it was later extended to cover the entire city. Installation of the system followed rapidly in many other cities throughout the country and today every progressive city possesses some sort of police patrol signaling system.

Like many other public improvements it was strongly opposed by the criminal element and for some time even by some police officers, but its advantages were soon apparent to the majority and the early defects remedied to further increase its usefulness and efficiency to both the police departments and the public.

For about 20 years fire-alarm practice and principles were followed in the police systems by connecting the boxes in series on closed loops radiating from the central station where recording and operating apparatus and central batteries were located. This necessitates use of closed-circuit types of boxes and devices. The opening of a circuit at any point put that whole circuit out of commission until it was repaired. Moreover, unless the circuit was well balanced, telephone communication proved to be very noisy, especially when higher-voltage systems came into use.

This was later overcome by the third-wire system, connecting the boxes all in series on a closed metallic circuit, or on one wire and a ground return. One of these two box-circuit wires was made the common wire of the system and the telephone instruments connected between it and the third wire, these two latter wires being run close together and transposed when necessary. Experience later proved that closed circuits were not necessary for police work, as the system is under periodic and regular test by the police officers when they make report calls.

Gravity cells were used at first and later came the dry cell and local-battery systems, but finally the storage-battery was adopted and now is very generally used.

The latest systems we have today were evolved out of these original ones and gradually conformed to the best telephone and signal practice of the times, giving the open-circuit central-energy storage-battery system as the highest standard yet reached.

Police Patrol Signal Boxes.

Any one of various types of open-circuit street signal boxes may be used, these having one or more report and emergency calls up to seven. Usually they provide for three or four emergency and three or four report calls, such as "wagon," "telephone," and "ambulance," and reports "1" to "4" for the use of a number of officers covering the same beat.

As shown in Fig. 1, these calls are selected by the patrolman by moving the arrow-shaped selective pointer to the call desired to be transmitted. By means of a shaft passing through the inner door to the signal movement on its back a character or "star" wheel is moved through a corresponding angle and selects a certain number of prefix dashes or dots for any signal. The movement is of the non-tension type, being spring-driven and wound, and released by a non-interference pull below the index pointer, which releases the mechanism when fully wound and pulled clear down. These movements are so timed for each box number as to transmit one complete

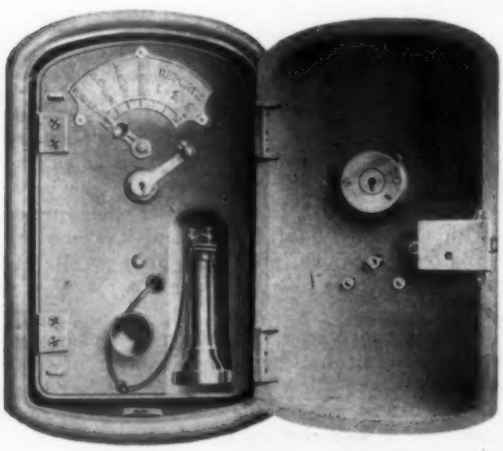


Fig. 1.—Open-Circuit Street Signal Box.

Fig. 2.—Mechanism of Street Signal Box in Inner Compartment.

round at fast speed of about six seconds, regardless of its number of units or digits. The corresponding box number is cut on detachable signal wheels, upon which a key break with contact-making springs bears; these springs are so actuated

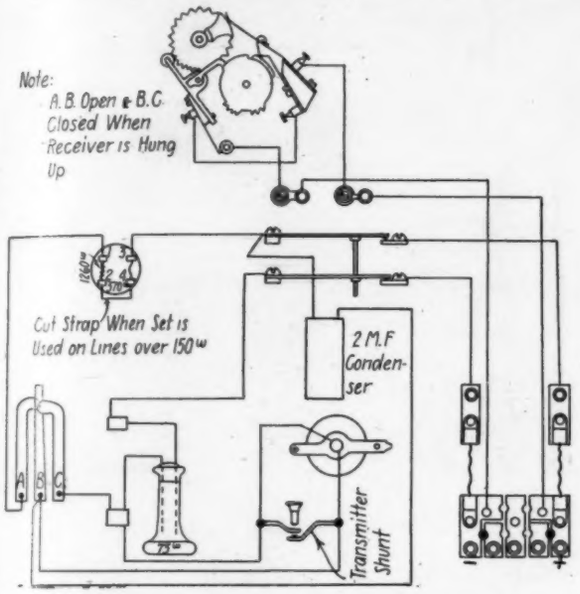


Fig. 3.—Wiring Diagram of Street Box.

by the signal and the star-wheel teeth as to close and open the circuit in their proper sequence and transmit the signal to the central station.

A pair of "series" and "shunt" contact springs mounted over the star wheel and actuated by an insulated sector on same are wired in series with the key-break contacts. They act as a master switch to control the nature of the signal transmitted. If an emergency call is selected, by placing the pointer at any one of these calls, these springs close and the circuit is completed when the key break passes over the long tooth and thereby causes a long closure to be made, which in turn operates the emergency "creeper" device and register on the central desk, as will be explained later.

When the pointer is set at any report call the combined action of the insulated sectors on the star and signal wheels causes the "shunt" contact to remain open until the long tooth is passed and then it closes to allow the prefix characters of that signal to be transmitted and followed by the box numbers, as shown in Figs. 2 and 3.

The telephone set consists of a standard transmitter, 75-ohm receiver, two-microfarad condenser, non-inductive resistance unit and switch hook. A double-pole cutout, operated by a plunger on the outer door, opens the telephone circuit when this door is closed and a combination pin switch and fuse block, with a one-ampere protecting fuse, serves also as a lightning arrester and test block.

When the outer door is opened by the officer and the receiver is on the hook an answer-back or "hummer" circuit is formed through the condenser, switch-hook contacts and receiver, as shown in Fig. 4. If at any time, while the officer is at the box, the central operator desires to converse with him a "hummer" signal is sent out by a low-frequency machine or interrupter, which produces a clearly audible sound by vibrating the receiver diaphragm.

Upon the officer lifting the receiver from the hook, the talking circuit is formed by contact springs, which connect the receiver, transmitter and resistance coil in series across the line, as shown in Fig. 5. A push-button, connected across the transmitter, serves to eliminate street noises on busy traffic corners. In some cases a tap bell and telegraph are installed in the box and connected in parallel with the movement key break, when it is desired to transmit special code signals.

In practice, inconveniences due to two or more boxes being pulled at the same time or one signal over another, thereby causing a confused signal to be recorded, do not often occur, as the officers' report schedules are so timed that their reports do not conflict. By reducing the number of boxes on each circuit to as few as economy will permit the chances of confusion are made more remote. Moreover, the officers are instructed not to pull a box if they hear the receiver "click," due to another box transmitting a signal.

Standard boxes are usually equipped with a "citizen's" trap lock that is accessible from the outer door of the box. Numbered keys for these locks are distributed to responsible residents of the community, whereby they can send in an emergency or fast-wagon call, on the index for which the pointer normally rests when the door is closed. By trapping the citizen's key the authorities can on responding to the call easily trace any false signals.

Installation of Boxes.

The signaling mechanism is inclosed in an inner metal case, which is mounted in a heavier cast-iron outer case designed to withstand rough usage and protect the signaling apparatus from dust and the elements of the weather. The boxes may be mounted on wood or iron poles, or on special police or combination fire and police pedestals, according to the requirements of the districts and the type of outside construction in use. The wires enter the box through a three-fourth-inch conduit on the pole for open construction and through the box-supporting pedestal in underground construction; a combination pedestal of the latter type is shown in Fig. 6.

Recent practice in both fire and police systems is to ground permanently and effectively both the inner and outer cases and any device with which an officer or citizen may accidentally or purposely come in contact in the operation of the box. By banding the inner and outer cases and movement together and grounding thoroughly to a water pipe or equivalent ground, and at the same time highly insulating all live current-carrying parts and providing adequate lightning protection, the danger to life is almost totally eliminated.

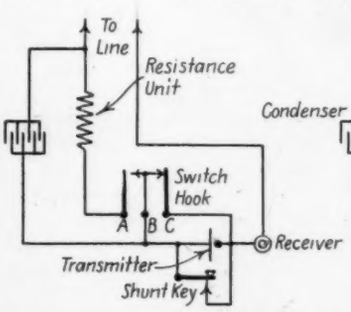


Fig. 4.—Arrangement of Hummer Circuit When Receiver Is on Hook.

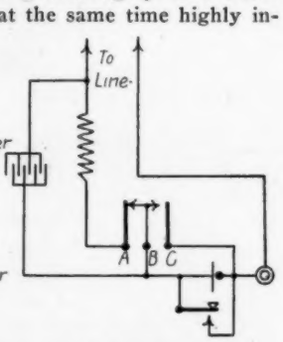


Fig. 5.—Wiring Diagram of Talking Circuit When Receiver Is off Hook.

Outside Circuits.

Street circuits radiate from the central office over the entire city and the boxes are connected in parallel thereon. The number on each circuit ranges from 10 to 20; depending on the locality served. In large cities there may be many hundreds of boxes on the system and connected on scores of circuits. When any system becomes very big substations are installed in several sections of the city and these connected by trunk circuits to the chief operating desk at headquarters.

The outside circuits may be run entirely overhead or

entirely underground or a combination of the two types of construction adopted, depending on local conditions.

Overhead circuits may be of No. 10 or No. 12 bare or insulated copper or iron wire, run 18 to 24 inches apart on two-pin cross-arms, above or under other wires and transposed at intervals, depending upon the proximity of other wires and inductive influences. In some cases twisted-pair insulated copper or iron wire is used, being easier to install and giving an almost perfect transposition.

Underground wires are run in lead-sheathed multiple-conductor cables, made up of rubber or paper-insulated pairs. The cables are laid in fiber or clay ducts. In localities where the expense of installing a new and independent underground duct line would be great, the local telephone

Fig. 6.—Combination Type of Fire and Police-Box Pedestal.

company's cable pairs or one or more of its ducts can frequently be leased for a quite reasonable sum.

Cable terminal or junction boxes are used at intersecting points and on long underground runs or where a change from underground to overhead construction is made. The lines are connected to terminal or fuse strips and continued to other boxes or lines, thus affording a convenient test and reconnecting point.

All outside circuits enter from overhead or underground and pass through lightning arresters, circuit breakers and sneak fuses to the rear of the operating switchboard desk in the police department headquarters.

Desk Switchboard.

The operating desk may be any one of several types suited for different sized cities or constructed to meet special conditions. However, the general scheme of recording and transmitting signals is the same on practically all of them, and therefore the standard type of desk only will be described here.

This desk is a complete unit in itself, outside of the storage battery for providing the energy, and is built up of unit panels, which may be added as the growth of the city requires additional circuits. The primary or controlling panels are necessary even for one box circuit and the circuit panels may be added at any time by simply removing

Fig. 7.—Typical Operating Desk, Showing Spare Panels.

a spacer, placing the circuit unit in its place and connecting the keys and relays to the spare wires originally provided, as shown in Figs. 7 and 8.

Emergency Calls.

Emergency calls will first be dealt with, as they are of primary importance and the right of way is given to all such calls, followed by report, telephone and flashlight calls, in the order named.

From the line terminals on the back of the desk each circuit passes through a reversing key, by which the polarity of the line may be reversed, to secure improved talking conditions, if the necessity for such arises.

Here each line is tapped through transfer keys to the test panel and test keys, where the current and voltage

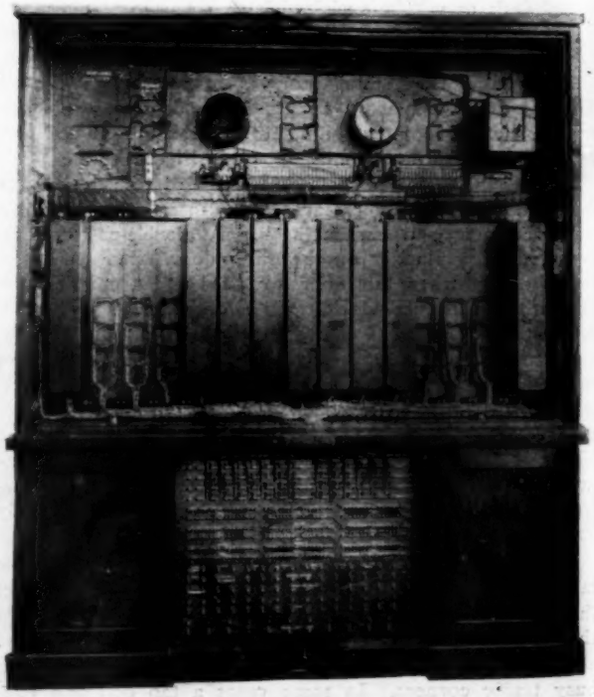


Fig. 8.—Rear View of Desk with Terminal Board at Bottom.

of any circuit may be read on the charging-panel instruments and the inside and outside lines tested for right and left grounds by connecting to the 24-volt local test battery.

Telephone and signal-call tests can be made on this panel by switch keys that connect equivalent resistance values across the line to give similar operating currents to that of a distant box.

From the reversing key each box line passes through each half of the 97-ohm telephone and 7-ohm signal relays in series, and in such a manner as to balance each side of the circuit inductively, then to the 48 or 60-volt common main-line storage battery, as shown in Fig. 9. The latter voltage is used only in special cases, as will be explained later.

The signal relay, through its armature, completes two local circuits, one from the armature and front contact to the register test and cut-off key, to one pair of magnet coils in the recording register, another is through the 520-ohm

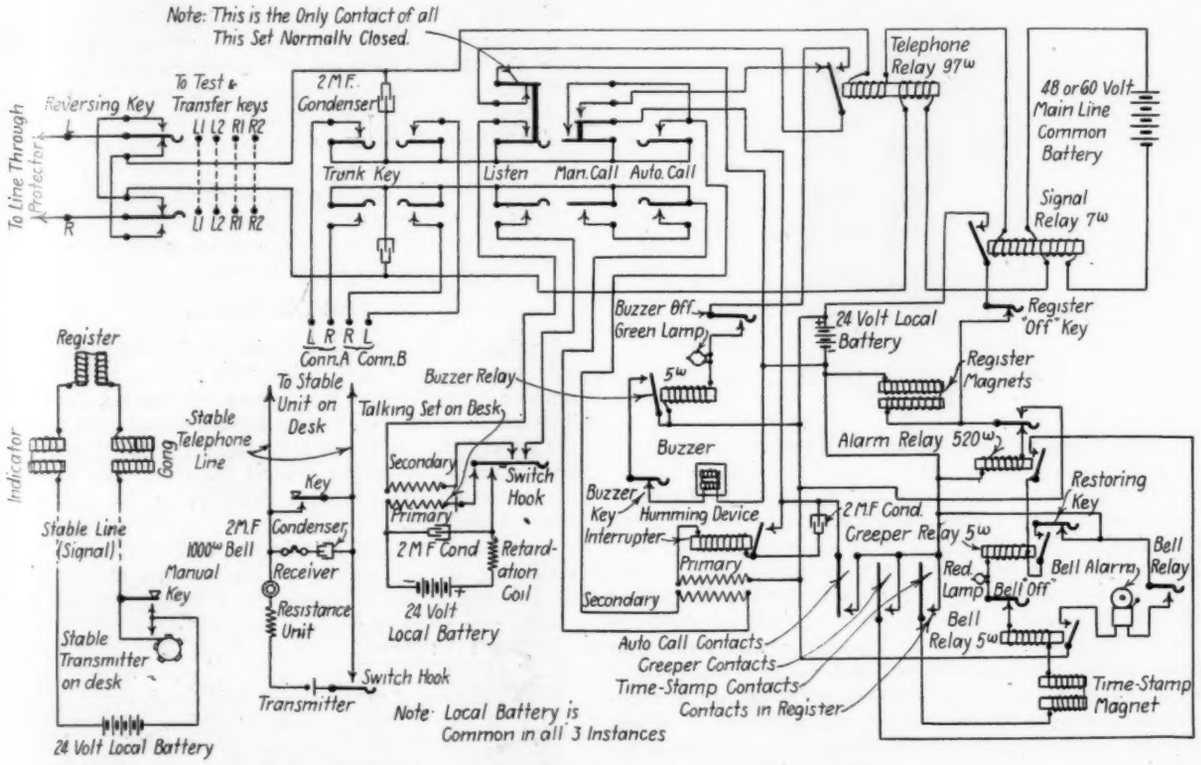


Fig. 9.—Wiring Diagram of Police Signal Operating Switchboard.

"alarm" relay, which in turn, through its armature and in conjunction with the "creeper" contacts in the register, which close on emergency calls, completes another local circuit by way of the red signal lamp, key and 5-ohm bell relay. The latter, through its armature, completes the vibrating alarm-bell circuit, as shown.

The attraction of the "creeper" relay armature forms a duplicate circuit to that provided by the alarm relay, to hold the armature of the former and continue the audible alarm after the register creeper contacts open.

Regular Report and Telephone Calls.

A regular report call from any street box will function all of the above apparatus, with the exception of the emergency alarm devices, and will be recorded by the register, also the exact time and date it is received will be automatically printed on the paper tape.

As there are not any long closures in the constitution of a report call, the visual and audible emergency signals are not operated, due to the creeper contacts remaining open, as a short closure will not hold the register magnet armature for sufficient time to allow the paper pawl to travel far enough on the tape to close the creeper contacts.

Telephone calls of an emergency character are recorded and answered in the same manner as other emergency calls. An ordinary telephone report call only operates the usual and audible telephone signals, which are distinguishable in color and tone from emergency signals.

The telephone relay operates on every signal transmitted on the circuit, but is so adjusted as to respond to a low current, since when the talking set is bridged across the line and the current flow limited to less than 50 milliamperes, this will not function the signal relay and emergency alarm.

The attraction of the telephone-relay armature completes a local circuit by way of the listening key, armature and front contact. through a green lamp and 5-ohm buzzer relay, as shown. This calls the operator's attention and he immediately cuts off the buzzer, by pressing the listening key, and at the same time connects the desk talking set to the line through condensers to receive reports from the officer or transmit orders to him.

Official and Hummer Calls.

One or more official and trunk lines are connected to the official panels and the chief of police or other high officials may converse directly with the desk operator or with any officer in the city, or in cases of general orders an official can talk to a number of patrolmen by the latter listening in. When used in conjunction with a private-branch exchange or central-office telephone system, any high official or any officer may be connected to a trunk line by keys through connections *A* and *B*, as shown.

If the desk operator wishes to call the patrolman before he leaves the box, after making a report call, the "manual call" key is closed, which completes the primary circuit of the "hummer" device through the buzzer, telephone-relay armature and back contact and listening key; and the sec-

ondary of the induction coil is connected to line through the condensers. By passing the circuit through the listening key and armature contact, the desk operator cannot then accidentally hum the receiver of the box telephone, as

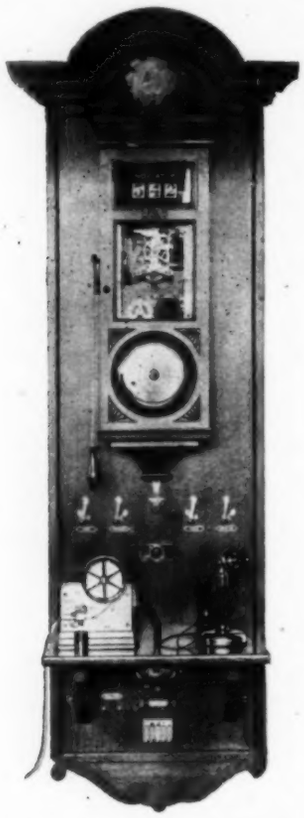


Fig. 10.—Stable Receiving and Recording Apparatus.

long as the listening key is closed or the receiver off the switch hook, thus saving many a "cuss" word by the officers.

If the operator wishes to communicate with a certain officer on a beat at the first opportunity the "automatic call" key is closed, connecting the secondary of the hummer to the line. As soon as the officer makes the next report call the "automatic call" contacts in the register are closed, the receiver of the transmitting box is automatically hummed by sending out a low-frequency current which vibrates the receiver diaphragm several times per second.

Terminal and fuse connection blocks are mounted on the rear of the battery controlling panel and each local circuit is protected with an "alarm" fuse which closes a local bell circuit when any fuse blows, thus calling the operator's attention.

The Stable Alarm.

All emergency calls requiring the wagon or ambulance are relayed by the operator to the stable or garage, where the corresponding street-box number is recorded so that the drivers can readily determine the locality whence the call came.

From the "stable" panel on the desk an alarm circuit connects to the stable receiving and recording apparatus shown in Fig. 10. This circuit includes a stable transmitter on the desk, upon which the box number is set up in duplicate and an indicator, gong and register operated from the local 24-volt battery, as shown in Fig. 9. The telephone circuit is entirely independent of the signal circuit. This arrangement is attained by using a separate pair of wires direct from the desk to the stable telephone set, which consists of a receiver, transmitter, resistance unit, and 1,000-ohm bell across the line through a condenser. Conversation can be carried on with any official or street box through keys on the desk. A machine ringer or interrupter is provided on the desk for calling on the stable and official circuits.

Current Control.

The signal relays are adjusted to operate on a maximum of 200 milliamperes and the telephone relays on 40, while the local relays and apparatus require from 100 to 500 milliamperes of current.

In the majority of cases the 48-volt battery is of sufficient voltage for the average line resistance, and in some instances too high, requiring additional resistance in the boxes near the central station to reduce the operating currents to normal values. Another remedy is to install a battery of the proper voltage for the average circuit and put a few extra dry cells in the very distant boxes or at a point in the line where it will boost the current on the "low" boxes.

If many of the circuits are very long, the common central battery should be increased to 60 volts and in this case the shunt straps on all resistance units are cut, to introduce an extra compensating resistance in the talking circuit and hold the current at its normal value, otherwise the talking may be impaired and if a number of officers were to remove their receivers on the same circuit the sum of the individual currents would equal that of the signal relay and operate same. Adjustments are initially made so that about six receivers can be removed before the signal and emergency relays operate.

Flashlight Signals.

Except for the humming device, so far the system works only one way and the saying "It's a poor rule that only works one way" seems to apply to this system. To further increase its efficiency, emergency-call signals are placed at the street boxes, in the most up-to-date installations. These are under the operator's control from the desk so that he may summon any officer in the city, or the entire police force if need be.

Visual and audible signals are placed on each circuit, consisting of a green light at night and a bell or horn

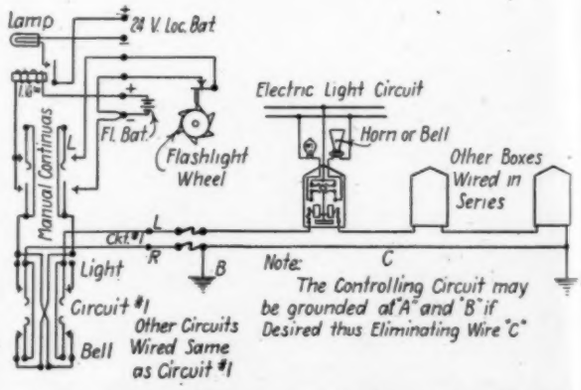


Fig. 11.—Wiring Diagram for Flashlight and Horn Signals.

in the day-time. They are controlled through polarity-reversing keys on the flashlight panel, as shown in Fig. 11. Primary circuits are run out from the desk to relay controllers, which through their armatures complete a secondary circuit to the bells, horns or lights, which are connected to the 110-volt lighting mains.

These relays are polarized and may be connected by any of the following methods. A group of them can be connected in series on a metallic circuit, or on one wire and grounding the last relay and the other side of the battery

at the office. Another method is to connect them in parallel groups on metallic circuits or between one wire and ground and grounding the office battery. The former method is usually to be preferred as the second scheme draws heavily on the battery and trouble may be experienced.

Any code of signals, such as riot or militia calls, may be sent out manually with a telegraph key, or by a simple movement, providing for continuous flashing, or code wheels with teeth cut to correspond to the street-box numbers, and any officer called by flashing his box number.

Battery Charging.

Storage batteries have been almost exclusively used in recent years for police signal systems, as they have proved far superior to any other source of energy for emergency duty, and give excellent results for both signal and telephone work.

They are controlled and charged from a separate switchboard, or one combined with the desk, as shown in Fig. 7. Duplicate sets of the main, local, telephone and flashlight batteries are provided and alternately charged or worked by double-throw battery-controlling switches and rheostats.

They are charged from any direct-current source of 110 to 500 volts through resistance lamps to reduce the voltage and current to the proper value. A no-voltage underload relay in the charging circuit protects the battery against voltage failure, underload and reverse polarity.

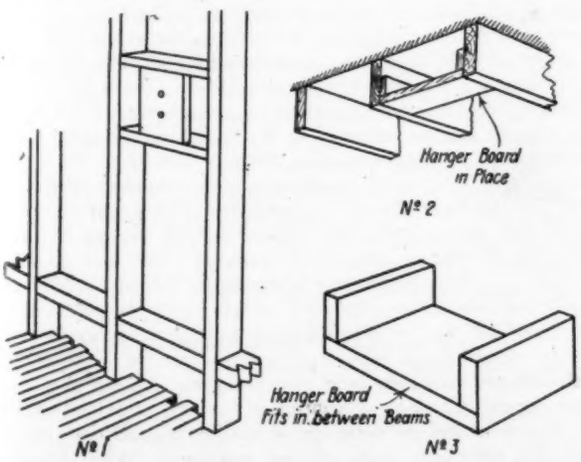
After 36 years of experiment and invention the Gamewell system described above is the final product, protecting millions of people in this country from coast to coast. It has greatly increased the efficiency of police departments by permitting prompt co-operation between headquarters and the patrolmen wherever it has been installed, and has borne out the truth of the statement that electricity is a necessity to the modern policeman.

Hanger Boards for Bracket and Ceiling Fixtures.

By Earl C. Thompson.

It is quite common to find hanger boards for fixtures poorly or carelessly installed. The following methods for straight electrical fixtures in new houses may not be new nor the simplest, but I have found them to be strong and very satisfactory.

As most brackets in my experience are now oblong or oval,



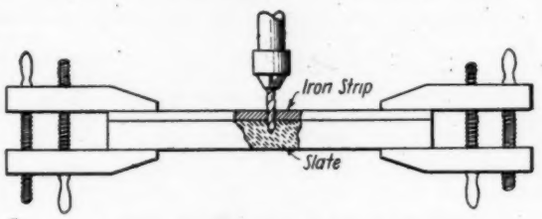
and are fastened with screws, a small, narrow board between studs will not catch the screws. The one shown in the sketch No. 1 will.

For ceiling fixtures I never use a board less than four inches wide and nearly all are over six inches wide, so that the board will catch all the screws from a six-inch uninsulated canopy, if screwed on without a crowfoot. I make the hanger as shown in sketch No. 3 and secure it in place as shown in sketch No. 2. This makes a very solid hanger and one that will stay in place. It takes a little more time to install than nailing a board directly onto the joists or beams, but it is much safer.

Drilling Hard Spots in Slate.

By H. B. Stillman.

Quite often in drilling slate the drill will strike a hard spot of flinty character, so hard that the drill will slide off to one side, bringing the finished hole far out of proper line.



Jig for Drilling Hard Spots in Slate.

This trouble may be overcome by drilling in a strip of iron or brass the same size hole that is required in the slate, then clamping both ends of the strip to the slate, with the hole directly over the hard spot to be drilled. This acts as a jig and holds the drill in a steady position, directly on the center.

Among the Contractors.

The Harwood Electric Company, Hazelton, Pa., will install a lighting system at Conyngham, which is near Hazleton.

Clark & Shuck, 44 State Street, Perth Amboy, N. J., will install motors and other electrical equipment for a refrigerating plant in the Gross Building, Fords, N. J.

The William Slater Electric Company, Memphis, Tenn., has been incorporated with a capital stock of $10,000 by William Slater, Thomas H. Jackson, J. L. McRee and others.

F. B. Trissler & Company, Lancaster, Pa., have received a contract for the installation of electric fixtures and other electric work in the addition being erected to the local plant of the Hamilton Watch Company.

The Empire Electrical Company, Kansas City, Mo., supplied the electrical equipment for the Kansas City Automobile Show and the wiring and equipment for the Kansas City Tractor Show, held the week of February 12 to 17. A temporary substation was installed for the purpose of converting the alternating current to direct for use of exhibitors. About 165 kilowatts in special lighting was installed.

Louisville, Ky., contractors are making preparations to file bids for rewiring of the Louisville Government Building for which bids are expected to be taken shortly in connection with the proposed appropriation of about $20,000 for the purpose. The present wiring installation was put in 24 years ago and is now not only obsolete and inadequate but is reported by the government inspectors to be actually dangerous. The new wiring will be a conduit job throughout, concealed in the walls, and the contract will provide for new electrical fixtures throughout the entire building.

QUESTIONS-ANSWERS

All readers are invited to submit questions and answers to this department. Anonymous communications will not be considered. Questions may relate to electrical matters of any kind. Answers contributed by readers should be submitted preferably within eight days of the date of publication of the question and should be limited, if possible, to 300 words. Payment will be made for all answers accepted and published.

Questions.

No. 381.—Ventilation of Flush Ceiling Fixtures.—Is it reasonable to insist on special ventilation upward in the case of a 100-watt fixture depressed flush in the ceiling? A series of these fixtures with glass bottoms is set into the ceiling under a balcony of a theater where there is limited headroom. There is a small ventilating clearance between the sides of the fixture and the frame for the glass bottom, but the inspector insists that a ventilating duct be run upward.—V. S. C., Buffalo, N. Y.

No. 383.—Overloading Motor-Driven Blower.—We have a 20-horsepower motor running at 3,600 revolutions per minute and direct-connected to a blower that furnishes 2,100 cubic feet of air at 1.5 pounds per square inch pressure. We find that the motor is overloaded by about 30 per cent. We cannot use a larger motor, as it has to sit on a base that is part of the blower frame. Would it be practical to install another blower so as to furnish air to the first one at a pressure of, say, 0.5 pound and thereby relieve the overloaded motor of part of its load?—H. D., Detroit, Mich.

No. 384.—Design for Small Transformer.—Will some reader kindly give me the size and amount of wire to use, size of core, etc., to make a small dry-core transformer with 2,200-volt primary and 5-volt secondary. The secondary current should be 6.6 amperes. I prefer a round core, but a square one could be used.—W. I. C., Modesto, Cal.

No. 385.—Peculiar Motor Trouble.—We have an alternating current motor which is causing some trouble that we cannot locate. The motor, which is used in a jeweler's shop to drive a lathe and polisher, is a one-eighth-horsepower Fidelity motor operating on a 110-volt circuit. After the motor has been operating for about thirty minutes on three-quarters to full load, the lamps in the shop lose about half their candlepower and a little later burn out. The building is wired correctly and the motor seems to be in good condition—it is a new motor. The motor is of the single-phase commutator type on which the speed adjustment is secured by shifting the position of the brushes. The meter used on this service is a five-ampere Fort Wayne. The lamps in the shop do not require more than one ampere when they are all burning. Any information in regard to the cause and remedy of this trouble will be appreciated.—L. H., Jetmore, Kans.

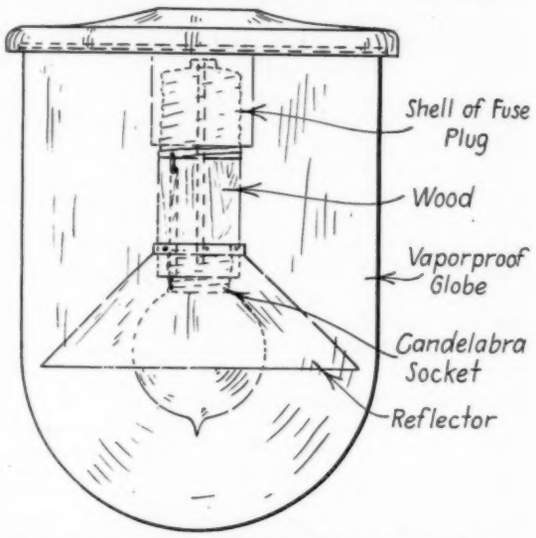
No. 386.—Electrolytic Production of Oxygen.—I would appreciate a brief outline of the electrolytic production of oxygen, explaining the process, apparatus required and cost of operation. Also, what is the market for oxygen?—T. P. B., Chicago, Ill.

Answers.

No. 382.—Lamp for Illuminating Lake Bottom.—We have a problem of trying to illuminate the bottom of a frozen lake for surveying the nature of the bottom before the ice breaks up, as certain work depending on this survey is to be undertaken at the earliest opportunity. The lake is 20 to 25 feet deep. It is proposed to use some kind of waterproof lamp connected by a cable to a storage battery, the lamp being lowered through holes punched in the ice at intervals. What kind of lamp, fittings and cable are suitable for this purpose? What size and voltage of lamp would be desirable?—F. G. T., Augusta, Me.

Answer A. I have used a lamp of the following description for spear fishing through the ice at night with good results. A pin could almost be seen at the bottom of 10 feet of water, so I should judge it would give satisfactory results at 25 feet. Take a six-volt 20-candlepower automobile-headlight lamp, one of the nitrogen-filled concentrated-filament type, and connect it with socket and length of waterproof cord, the same as an ordinary extension lamp or trouble lamp used by motorists. Wrap one layer of rubber tape over the socket, starting to wrap it close to or over the edge of the lamp, and continuing several inches up on the lamp cord. Over this wind tightly several layers of friction tape, then immerse, up side down, in melted paraffin wax. After the wax has hardened, wind enough tape around the socket to make an ordinary lamp guard fasten on tightly. Weight this on the bottom. Better results may be obtained for your particular case, if a flat tin reflector were fastened above the lamp. Use a six-volt storage battery. —A. H. M., Hamilton, Ont., Canada.

Answer B. Use a vaporproof globe, such as the type put on the market by Henry Newgard & Company, of Chicago, and solder pigtails to rubber-covered wires, covering the joints with some waterproof compound, like Chatterton compound. This device may be lowered to the desired depth. In order to use this fitting in connection with a low-voltage candelabra-base lamp, construct an adapter, as shown in the sketch. Take a



No. 382.—Answer B.—Waterproof Low-Voltage Lamp.

round piece of wood and on one end mount a shell of a fuse plug and a center contact and at the other end a shell of a candelabra socket or receptacle with a center contact. Drill one hole through the center of block through which run a wire connecting the center contacts. Drill one hole on a slant from end of fuse-plug shell to just outside the candelabra shell and run wire through this and solder the ends to the shells. Mount a reflector made of tin on the wood block. The outside diameter of the reflector must be smaller than the inside diameter of the glass globe of the vaporproof lamp. Length of adapter to be such that bottom of reflector will be at the point where the glass globe curvature starts. Use a six-volt gas-filled lamp with six-volt storage battery.—M. W. J., Milwaukee, Wis.

Answer C. I would suggest using a gas-filled Mazda C lamp of 6 or 8 volts, 36 candlepower, bayonet base; these are used for the headlights on automobiles. They can be used either with the ordinary dry cells or a lead storage battery, whichever is most convenient or available, a sufficient number of cells to suit voltage lamp being used. For the cable use what is known as brewery cord or any Code rubber-covered twin wire size No. 18. For the lamp end use a bayonet socket No. 14. Insert lamp, connect cable to connecting posts, cover with ordinary insulating tape from the glass of lamp to a distance beyond the place of connection between posts and cable, and then over this one wrapping of rubber tape and lastly paint well with some good waterproofing compound. When dry the outfit is ready for use. If it is desirable to concentrate the light rays downward and prevent glare from the bare lamp, slip over the cable so as to cover the lamp one of the 8 or 10-inch metal reflectors that are used in connection with headlights on automobiles. I have used a similar outfit myself with most satisfactory results. The parts are all standard and cheap. It is necessary to weight the bottom.—F. F. H., Milwaukee, Wis.

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"LET THE CODE DECIDE."

Secretary's Message.

As members will have seen very likely in the "Dates Ahead" column of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN the biennial meeting of the Association will be held in New York City on Tuesday, Wednesday and Thursday, March 27, 28 and 29, headquarters being at the Hotel Martinique, Broadway and Twenty-eighth Street, as two years ago.

President Wynkoop has appointed the following Committee on Arrangements: Chairman, Alfred E. Braddell, Sprague Electric Works, 527 West Thirty-fourth Street, New York; H. S. Draper, 1227 West Forty-sixth Street, Brooklyn; Thomas J. Spence, 52 Portfield Place, Freeport, Long Island; Thomas H. Day, 59 Deerfield Avenue, Hartford, Conn.; A. H. Lilley, 3826 North Seventh Street, Philadelphia; Henry A. Knight, City Hall, Worcester, Mass.; W. Lincoln Smith, Concord, Mass., secretary.

Chairman Braddell writes me that he has arranged for our meeting (business sessions, etc.) to be held in the same convention hall as before. It will open at 10 a. m. Tuesday. The banquet will be served at 7 p. m. in the adjoining Oak Room. The price of "eats" being unavoidably advanced somewhat, the price per plate will have to be put at $2.75. "Brad" says this may seem high to some, but they must remember that "eggs has riz." He has given a guarantee of 60, which I feel sure the members will make a mere bagatelle when I recall the hundred plus of two years ago. I am not at this writing able to give a statement of the speakers and subjects planned, but can only say they include some good technical addresses illustrated with moving pictures, as well as A1 after-dinner speaking.

I give here the room rates as arranged specially for the convention, per day:

Single room on court, $2; on street, $2.50 and $3.

Single room with bath, on court, $2.50 and $3; on street, $3.50 and $4.

Double room on court, $3 and $3.50; on street, $3.50 and $4.

Double room with bath, on court, $3.50 and $4; on street, $4.50 and $5.

Two connecting rooms, with bath between, for two, three and four persons, from $5 to $10, according to number and location.

As some of our members are on the Electrical Committee of the National Fire Protection Association, which meets on Monday, members may take rooms from Sunday on.

The matter appearing in this section consists of questions on the National Electrical Code, its interpretation and meaning, and questions as to whether certain methods of wiring are in accord therewith. These questions are gladly received from anyone interested, even if not a member; they should be sent to the secretary with any needed elucidating sketch. They are answered by each member of the Executive Committee according to his knowledge of what the ruling would be in his jurisdiction.

It should be understood that no pretense is made to give an authoritative interpretation of the Code. This is a voluntary association; it has representation on the Electrical Committee of the National Fire Protection Association, which prepares the Code, but it has no right, and claims no right, to give a final interpretation of anything in the Code. It is only intended to give the interpretation which seems correct to the members of the Executive Committee. No attempt is made to edit or correlate the answers from the different members of the Committee, as it is felt that the occasional difference of opinion is calculated to lead to a further study of the matter in question, further discussion and the final clearing up of obscure points.

The aim is to help toward a better understanding of the Code on the part of all; a more uniform conception of its meaning; increased precision in applying it; and harmonious action of those using it, for the common good.

The business hours of Wednesday and Thursday morning will be given up to the general meeting of the Electrical Committee at 123 William Street, opening at 10 a. m. I should think from the bulletin on suggested changes sent to me, that the meetings would be over before noon Thursday, and if this should be so, we shall plan some excursions for Thursday afternoon.

Owing to the high cost of materials and printing, I am not planning to send copies of the bulletin broadcast as was done two years ago, but any member desiring a copy may write direct either to Mr. Sweetland, 141 Milk Street, Boston, or to Secretary Wentworth of the National Fire Protection Association, Equitable Building, Boston, or to me and I will get him a copy.

The most important matters in revision of the National Electrical Code to come up are, to my mind, the report of the Committee on Grounding, which involves a recodification of all grounding requirements, a grouping and simplification which will make the whole matter much clearer, also the report of the Switch and Cutout Committee, which contains much important matter. The former is referred to elsewhere in this issue.

The Secretary has received recently several questions, which originated with one of our members, formerly a city inspector and a member of our Executive Committee, upon which he did some of the best work that appeared.

Instead of sending them to the Executive Committee, as customary, I am printing them below, and I particularly request that members of the Association, whether on the Executive Committee or not, (also, if they desire, persons interested even though nonmembers) would let me know their views on them so that they may be printed here for the interest of all concerned.

Grounding of Service and Interior Conduits.

Question 339. Rule 12*f* requires grounding of service conduit, and specifies that such ground connection shall be independent of, and in addition to, any other ground wire on metal conduit, armored-cable or metal-molding systems within the building. Is it permissible to then regard this service-conduit ground as fulfilling the requirements of 28*f*; that is, may the interior conduit system depend for its grounding on that of the service conduit to which it is metallically connected? I might state further that in this city the service conduit is in all cases installed by the interior-wiring contractor, so that he would not be dependent on the possible failure of some one

else. If two groundings are to be required, explain why this is so.

Common Service for Several Tenants in a Building.

Question 340. Consider the case of a building having four or five small stores on the ground floor (each with its own basement) and several very small apartments on the second floor; each store and each apartment is to be wired for one circuit only. There is no public or open hall or stairway, no common basement or other room to which all tenants have access, no heating plant and no janitor or custodian for the building. It is proposed that all meters, cutouts, and main switches, including service cutout and switch for the entire building, be located together in the basement of the corner store, there being no place more "accessible" in which the service could be placed. What action would you take as an inspector in the matter? The rules of the service company permit only one "drop" or service entrance to any one building, and require all meters to be placed at one point, in basement.

What is Code Meaning of Accessible?

Question 341. Define the word "accessible" as used in the Code in connection with the location of service switch and cutout. Must it be understood to mean accessible to each individual tenant of a building in circumstances like those cited above? Where there is a resident custodian or janitor, or resident owner, is accessibility to him all that is required? Or is it the intention that accessibility to the fire department be understood? And if the latter, why? Should not the possible loss of life resulting from the shutting off of light in a burning building far outweigh the very doubtful saving of property that might follow the removal of "the electrical hazard" from an already burning structure? Isn't this rule based entirely upon property or insurance considerations, and wasn't it incorporated in the Code before the latter had begun to recognize the existence of other than property losses?

Secretary's Comments on These Questions.

It must be clearly understood, that in expressing my own views on these questions they are simply my own personal ideas, they in no way represent anything else and are in no way to be taken as representing the opinions of the Executive Committee, any of its members or of the Association.

The first question is of course distinctly one having to do with the interpretation of the Code and as such properly one to be sent to the Executive Committee, but it seems entirely unnecessary to do so for the reason that there can be no possible question upon it.

The last sentence of Rule 12*f* reads as follows: "This ground connection to be independent of and in addition to any other ground wire on metal conduit, metal-molding or armored-cable systems within the building."

As it stands now, although the wording is "to be independent of" and not "must be independent of," there can be no mistaking the intention that there must be entirely separate and independent grounds for the service conduit and the building-conduit system.

In the bulletin of proposed changes in the Code which are to come up the last week of March, in the report of the Committee on Grounding we find that in a new rule designated as "15A. Method of Grounding, When Protective Grounding is Required," (see page 367 of this issue) very clear and very lucid requirements for grounding are proposed. At the same time certain changes are proposed, one of which is as follows:

12. Wires. Section *f*. Amend third paragraph to read:

"Metal conduit containing service wires must be *grounded as provided in Rule 15A, unless the conduit is insulated* from the metal conduit, metal-molding or armored-cable system within the building and from all metal work on or in the building. *When the service conduit is so insulated, it may be grounded either direct, as provided in Rule 15A, or by connection to the grounded service wire.*"

Another proposed change reads,

28. Interior Conduits. Section *f*. Amend to read:

Must have the metal of the conduit *grounded as required in Rule 15A.*"

Similar changes are recommended in Rules 27 and 29.

Now when we turn to the proposed new rule 15A, we find (at least, as I read it) only one section referring to the question at hand, namely, Section *m*, first paragraph, (Page 10, Column 1, of the bulletin) which reads:

"If an armored-cable system, a conduit system, or a metal-molding system, consists of several separate sections, the sections must be bonded to each other, and the system grounded, or each section may be separately grounded."

As one reads this the question immediately rises in one's mind—In such cases is the service conduit a part of the "system," or is it an entirely distinct "system"? Personally, I should assume it was an integral part of the "system," certainly if metallically connected to the building conduit, and under the changes as proposed there might be either one ground for the whole thing or separate grounds for the service and building sections as seemed best, probably the determining factor being the length, capacity, and circuit constants of the service branch, together with the method of feed and protection at the point of attachment to the distribution mains.

Just as certainly as the Code stands, at present there *must* be two grounds. It is therefore legitimate to assume that the committee felt the need of this change for reasons which were doubtless good and valid and which will probably appear in discussion later on.

This brings us up to the last sentence of the question, "If two groundings are to be required, explain why." Here the Secretary has no opinions worth while stating, and would like exceedingly such opinions from members.

Questions 340 and 341, on the other hand, are not matters of Code interpretation and as such, in the opinion of some members of the Executive Committee, not properly referable to it. The first, for instance, might involve several matters found in the local building regulations on existence of party walls, etc. In my own case I think I would probably require a service cutout and switch in the basement of the corner store, a conduit line running through the group according to Rule 17*d*, with fuses, switch and meter unit of the group. Or possibly the line might be carried along the building outside and through the wall into each unit.

It so happens that in my territory, the rules of the service companies are subordinate to the legally adopted bylaws and requirements of the inspection department.

Question 341 brings up the matter of "accessibility," which has been discussed in these columns several times. It also contains queries as to the purpose of the requirement. In some places accessibility by the fire department from without is required, in others accessibility from within only, with varying degrees of required accessibleness for switch and cutout. The requirement dates from early days when circuits were not well insulated, not run in conduit and not thoroughly grounded; it was very rarely a question of maintaining light in the building but rather of not intimidating the firemen. At present it is pretty rare that firemen have to contend with dangerous voltages in buildings (except possibly some alternating-current power lines in shops, etc.) and so far as my experience goes they usually prefer to keep the light on. At the same time I think it advisable that the accessibility clause be adhered to, even to the firemen from outside, because the mere fact that one can cut off, if necessary, renders one more confident and indeed less likely to desire to cut off power. That, at least, is the case in my own town. I could hardly think, off hand, of a case where we had to cut off the light in homes or stores, for our district chiefs always want it on and sometimes where a service wire has broken want it reconnected. At the same time we have wanted to cut it off promptly several times in the case of farm buildings, barns, etc., because the leakage, while not disturbing the men, was so alarming the live stock that the animals could not be gotten out, though the fire and smoke had not come close enough to seriously terrify them.

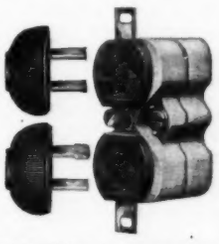
NEW APPLIANCES

A Review of the Latest Developments and Information Respecting Electrical and Kindred Mechanical Appliances

New Receptacles of the Standard Type.

Six electrical manufacturers have agreed on the making of standard plugs and receptacles, the attaching caps of which can be connected to all the bodies of the several makes. In the accompanying illustrations are shown the C-H No. 7711 "standard" single flush receptacle, C-H No. 7721 duplex flush receptacle and C-H No. 7717 surface receptacle, all recently brought out by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. The single and duplex flush receptacles are small, of white-glazed porcelain, and rated at 660 watts, 250 volts. The portions of the receptacles exposed through the

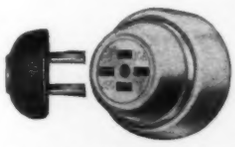
Single Flush Receptacle with Standard Parallel-Blade Attaching Cap.



Double Receptacle with Standard Cap Above and Polarity Cap Below.

apertures in the flush plates are black enameled, making a pleasing appearance and a surface which does not show soil. Each outlet is provided with four slots holding protected contacts; two of these are parallel to receive the blades of the "standard" parallel-blade cap or polarity cap, and two in tandem to receive the blades of the tandem-blade cap. Terminal screws are large and easily accessible.

The duplex receptacle is the same size as the single receptacle with double the number of outlets, allowing the attachment



Surface Receptacle with Standard Attaching Cap.

Porcelain Current Tap with Standard Parallel Blades.

of two electrical appliances from one outlet box and thus providing exceptional convenience and reducing the amount of wiring and installation expense. Large terminal screws are provided, one pair taking care of both receptacles. Grooves in the side of the porcelain body accommodate the conductors and prevent crowding in the outlet box.

The surface receptacle, like the flush receptacles, is of glazed porcelain with concealed contacts and slots arranged to accommodate standard attaching caps. It is designed for concealed wiring and has the same rating as the other receptacles.

Separable Motor Attachment Plug with Standard Cap.

Separable Cord Connector with Standard Cap.

A polarity cap with parallel blades, one enlarged to fit a correspondingly enlarged slot of the standard plugs and receptacles has also been recently brought out.

Disconnecting Pothead for Ornamental Street Lighting.

A disconnecting pothead was recently developed by the George Cutter Company, South Bend, Ind. It provides a receptacle of high insulation, where underground cables are connected to wires inside the post used for ornamental street lighting, and are hermetically sealed in. The pothead is provided with a removable top which automatically disconnects the wires leading to the lamp from the underground circuit, and closes the line to allow the remaining lamps to burn. This device greatly facilitates testing for grounds and allows repairs to be made with perfect safety.

Disconnecting Pothead.

Series Transformers Provide Safety for Series Lamps on Poles.

Series lighting circuits always involve an element of danger due to the high voltage ensuing on open circuits. In the case of arc lamps mounted on high poles this danger is overcome to some extent by the fact that all wires are high above the ground and out of reach. The lamps are handled only by authorized employees who are educated to the danger and take the necessary precaution. In the case of ornamental post lighting, which is now coming into general use, due to the development of high-efficiency lamps, there is the added danger of a ground in the post causing injury to pedestrians.

The external Luxsolite transformers recently developed

Series Transformers for Mounting in Base of Pole and on Pole

by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., render a series system of distribution safe, and prevent broken lamp filaments from opening the series circuit and putting a branch of the system out of commission. By the use of these transformers in the bases of ornamental poles, low-tension wiring may be employed in the poles, thus making the system safe and less expensive to install.

The external Luxsolite transformers have two windings not interconnected and therefore the lamps can be renewed without danger to the operator while the circuit is

alive. They are of the core-type construction. The case is of heavy sheet steel. For manhole service heavy tinned pipe outlets are provided on which a joint with the lead-covered cable may be wiped. Small feet are provided for supporting the transformer in the bottom of the pole base. For overhead service, the leads are brought out through the bottom in porcelain bushings, and a strap is provided on the side for mounting on the pole.

Before shipping, an insulation test of 20,000 volts is applied between the primary and secondary windings of each transformer.

The Gund Drive-and-Twist Anchor.

During the past five years there has been a remarkable development in the manufacture of anchors. It has also been noticed that at the same time there is a decided tendency towards eliminating the old-style "dead man" and replacing it with some substantial form of anchorage that requires no digging.

The extreme advances in cost of steel and of labor have made the old dead man practically prohibitive and while it is still good for extremely heavy loads, it is an unwarranted waste for ordinary light construction work on which 95 per cent of all anchors are used.

Probably the best example of a thorough test in this connection is that of the United States Government engineers who constructed the Panama Canal. It is conceded that the building of this canal is the greatest engineering feat ever accomplished and its decided success was the result of extreme care in planning and selecting material and machinery of the best quality that money could buy.

Original Drive-and-Twist Anchor.

New Drive-and-Twist Anchor in Driving Position.

Drive-and-Twist Anchor in Driven or Expanded Position.

When everything was ready to anchor the electrical lines which run parallel to the canal, the same care was used in trying out different forms of anchorage. The result of the tests showed the "Drive-and-Twist" anchor to be perfectly adapted to all of the great variety of soil conditions and to give a more reliable hold than any other form of anchorage. The engineers also found that it actually cost 33 per cent less installed than any other anchor.

As a result of these tests the government ordered 800 No. 3 Drive-and-Twist anchors for the first stretch of work. This was followed by additional orders and there have been used up to this time a total of 2,950 of these same anchors for the entire Panama Canal project.

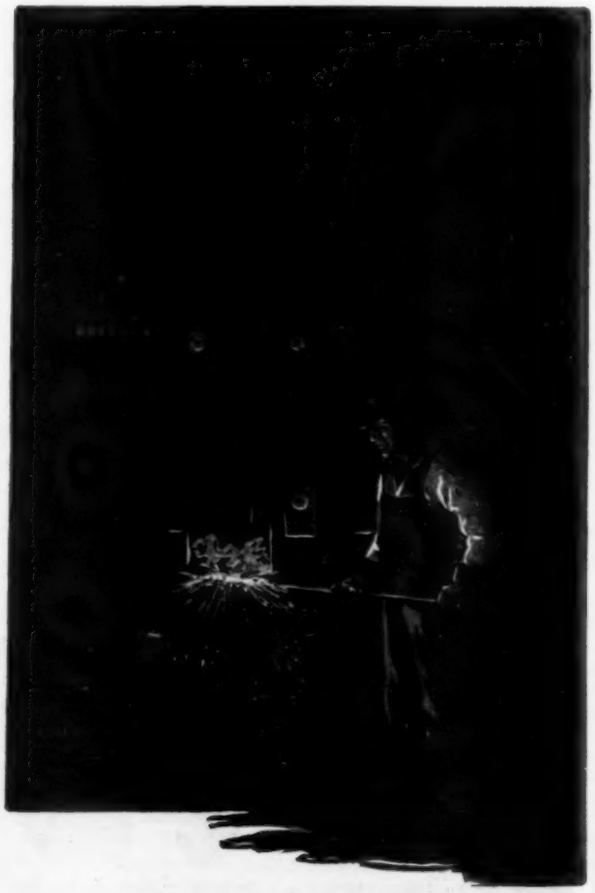
The very extensive use of Drive-and-Twist anchors has only been made possible by the careful development which the manufacturer has exercised in its making. As a matter of comparison, there is shown herewith an illustration of the first anchor of this type made. It consisted of a round shaft drawn to a point at one end and with a hole punched in at the other. It was equipped with two spoon-like blades.

Method of Driving the Anchor.

Twisting and Expanding the Anchor.

This old-fashioned anchor, although successful in favorable conditions, could not be used in hard ground and it was frequently damaged by obstacles in its path. It was first put on the market in 1906, during which year about 4,500 were used.

The new type Drive-and-Twist anchor is equipped with a steel pilot point shaped like a spear, which makes driving easy and enables perfect installation through gravel, roots or



Drop Forging Drive-and-Twist Anchors in the Gund Factory.

any obstacles in the ground. It is very sharp and its peculiar shape offers a perfect protection to the blades which follow in its path.

The eye on the new anchor is elliptical in shape and is drop-forged one solid piece with the rod. There are no threads, no castings, no welds. Just one piece of sound open-hearth steel from end to end. This is a decided improvement, because welds are seldom perfect and very frequently crack and break. Furthermore, the full load of the strain comes on the eye and the rod and it is absolutely necessary that this part be constructed so as to give perfectly reliable service.

All Drive-and-Twist anchors are now made under huge steam-powered forging hammers, which literally smash the eyes and points out of the raw material in one operation. The ends of the rods are first upset into the shape of a ball and then placed into the dies under the steam hammers which force out the shape under many tons of pressure. The equipment used is believed to be the most modern of any anchor shop in the world and while the Drive-and-Twist anchor is already being used extensively in every state in the union, as well as practically every foreign country, the manufacturer (the Gund Manufacturing Company, La Crosse, Wis.) is planning and bids fair to make its factory the source of anchors to supply the world.

New Developments in High-Tension Line Control, Protective and Outdoor Substation Equipment.

In recent years there has been rapid extension of high-tension lines supplying energy to small towns, railway substation, mines, etc., in which low cost of construction is an important feature. Equipment for this purpose has been

Fig. 1.—New Improved Air-Break Switch.

steadily developed that has made these extensions economically possible. A prominent manufacturer of equipment for this purpose is the Delta-Star Electric Company, 2439 Fulton Street, Chicago, Ill. A number of new improvements in this class of apparatus made by the company are shown in the accompanying illustrations.

A recent development in the type PM, form 2, three-phase air-break switch illustrated in Fig. 1, is the micrometer adjustment between phases. With this feature the three blades can be independently adjusted, thus insuring accurate and quick assembly in the field.

At the point of tapoff from main lines, the air-break switch with various combinations of choke coils and fuses has a wide application. The type MB form of switch assembled in vari-

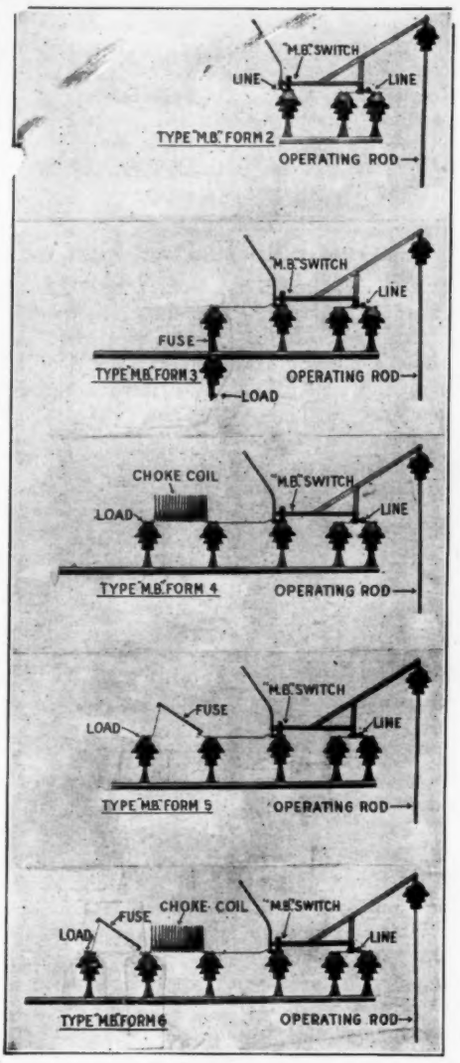


Fig. 2.—Combinations of Line Switching and Protective Equipment.

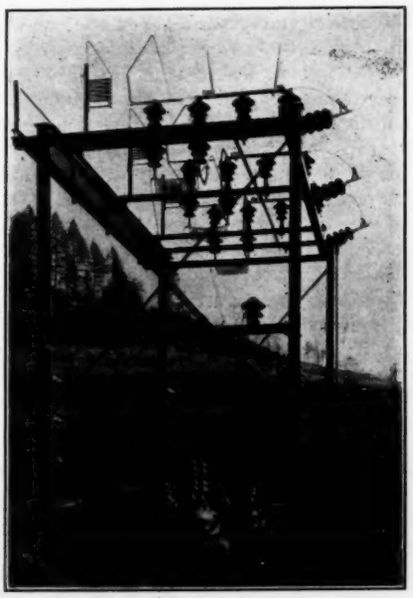


Fig. 3.—Unit-Type Steel-Tower Outdoor Substation.

ous combinations is illustrated in Fig. 2. This shows how easy it is to secure any desired switch, fuse and choke-coil arrangement.

The type VB steel-tower outdoor substation is made of unit-type sections, enabling a material increase in kilowatts capacity as the load increases. The steelwork supports the entire high-tension switching, fusing and lightning-arrester equipment, all of which is of the weatherproof type.

Moving-Film Electric Sign.

Motion in electric signs has long been shown to have superior attracting power to a stationary sign display. This idea has been carried out in the great variety of flashing signs and also those where a cycle of messages is thrown on the sign by means of intricate groupings of the stationary lamps. This idea is now presented in a very

Traveling-Film Sign Complete, Showing Internal Arrangement.

simple form of electric sign which employs a moving film that passes in front of a group of lamps. The film is an endless one and is kept in continuous motion by passing over certain driving and guide pulleys operated by a very small motor. The film is translucent and bears on it any desired message. This type of sign, known as the Arnold electric sign, whose general arrangement is well shown in the accompanying illustration, has been developed now for use principally as a show-window sign, although it can be used as well to hang up inside the store. The standard dimensions of the outfit are 39.5 inches long, 9.25 inches high and 9.5 inches wide. The net weight of the outfit is 31 pounds.

The sign is entirely inclosed in a box with an attractively finished border so as to give a pleasing appearance in the window or other place where it is displayed. The film itself may be of any length from six to 40 feet. Usually a 30-foot length is supplied. The film can be given any lettering desired and this will be taken care of by the manufacturer if the purchaser cannot have the lettering done. However, the lettering usually can be taken care of easily by an experienced sign-card writer. The film can be changed in a few minutes, so that it is possible to present entirely different messages from time to time.

In comparison with the elaborate "talking" electric signs, the Arnold sign is of extremely low cost. Although possibly not so mysterious, it is equally effective in attracting attention and transmitting its messages.

The sign is operated by a motor which takes only 20 watts for operating the film. During the day it is not necessary to light the lamps for illuminating the film itself, if the sign is shown in a window The group of lamps used for lighting the sign at night takes only a small current, so that the entire operation of the sign is very economical and can be taken care of from any ordinary lamp socket. The sign runs practically without noise and requires very little care to keep it in proper order. This sign comes complete ready for use and is made by the Arnold Electric Company, Racine, Wis.

Sprecher Lighting-Fixture Insulator.

The installation of fixture insulators is required in a great many cases. Various types of insulators have been placed on the market, of which a new patented design has been found to have a number of valuable features. This is the Sprecher lighting-fixture insulator illustrated in Fig. 1. The outfit consists of five parts. At the top is an iron cap of three-eighths-inch size which is screwed on the fixture stud. Into this is screwed either a four-inch stove bolt, in the case of conduit installation, or a 4.5-inch wood screw, if the fixture is in-

Fig. 1.—Sprecher Fixture Insulator.

stalled on a lath and plaster ceiling or wall. Surrounding the bolt or screw is a one-fourth-inch fiber sleeve which prevents the wires from coming in contact with the bolt or screw. The insulator proper is secured by the head of the bolt or screw and is made of an approved insulating material which has passing through it two wireways. Secured to the insulator is a connecting link that clamps into two depressions in the body of the insulator. To this link the body of the fixture or the supporting chain is fastened.

Fig. 2.—Interchangeable Fixture Using Sprecher Insulator.

In Fig. 2 is shown a bracket fixture using the Sprecher insualtor. This is a fixture typical of a line made for the double duty of either ceiling or bracket mounting. These fixtures are made in either plain or ornamental design. The Sprecher insulator is highly approved by inspection departments. It is manufactured, as well as the fixture referred to, by the Milwaukee Gas & Electric Fixture Company, 1910 Fond du Lac Avenue, Milwaukee, Wis.

ACTIVITIES IN THE TRADE

General Electric Company has decided to make an addition to its lamp works at Warren, O. The addition will cost about $250,000 and will offer employment for about another 400 men.

Harvard Electric Company, 525 West Van Buren Street, Chicago, Ill., manufactures ammeters, voltmeters and battery indicators, and has just issued a new catalog No. 25 illustrating this line of equipment.

Canadian SKF Company, Limited, 47 King Street, West, Toronto, Ont., Canada, has been organized under a Dominion charter for the manufacture and sale of SKF self-aligning ball bearings in Canada.

The Roessler & Hasslacher Chemical Company, New York, has issued its folder No. 333 for the month of February. The folder gives a list of various chemicals used in the electrical and other allied industries with the current prices of each commodity.

Opportunity for Electric Wire Manufacturers in India.—Edward S. Ezra, 93 Park Street, Calcutta, India, is desirous of receiving from American manufacturers of electric wire and cable price quotations, with samples of their product. He advises that all of his business transactions will be done with British or allied customers.

Federal Sign System (Electric), Chicago, Ill., at its last meeting of the board of directors made the following additions to the board besides re-electing all of the old directors: Frank J. Baker, William A. Fox, John H. Gulick, Martin J. Insull and Charles A. Munroe. Samuel Insull remained as chairman of the board. All of the new directors are located in Chicago.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces the receipt of the following orders for central-station apparatus. Two 1,200-kilovolt-ampere, 60-cycle, horizontal water wheel generators with direct-connected exciter, and switchboard, for the Fontana Power Company, Fontana, Cal. Two 1,875-kilovolt-ampere, 60-cycle, water wheel generators, switchboard, three 1,500-kilovolt-ampere, oil-insulated water-cooled transformers, and an equal number of 100-kilovolt-ampere transformers, for the Montgomery Light & Water Company, replacing older equipment. Three 2,500-kilovolt-ampere frequency changer sets and four 2,000-kilowatt booster rotary converters with air-blast transformers, for the Edison Electric Illuminating Company, Brooklyn, N. Y. Eight, additional 1,500-kilowatt rotary converters with transformers, for the Cleveland Railway Company, making a total of 20, 1,500-kilowatt Westinghouse rotary converters for this company. One 7,500-kilovolt-ampere auto transformer, four 1,200-kilovolt-ampere auto transformers, and two 7,500-kilovolt-ampere transformers for the Consolidated Gas Electric Light & Power Company, Baltimore, which is making extensions to its system. Six 500-kilovolt-ampere furnace transformers for the Alabama Power Company. Seven 3,000-kilovolt-ampere, oil-insulated, water cooled transformers for the Union Electric Light & Power Company, St. Louis, Mo. Three 7,500-kilovolt-ampere, oil insulated water-cooled transformers for the Northern States Power Company, Chicago. Two 2,250-kilowatt booster rotary converters with transformers and blower outfits for the Edison Electric Illuminating Company, Boston, Mass. The Cleveland Electric Illuminating Company, Cleveland, Ohio, has also ordered two 2,000-kilowatt, one 3,500-kilowatt booster rotary converters and 17 three-phase current limiting reactors.

Lux Manufacturing Company, Hoboken, N. J., making nitrogen-concentrated and tungsten lamps, has recently secured municipal contracts from the cities of New York, N. Y., and Philadelphia, Pa. Both of these cities have been testing various makes of lamps for some time and concluded that Lux lamps were best adapted to their particular needs.

Bradford-Ackermann Corporation, Forty-Second Street, Building, New York, N. Y., has recently been formed by A. H. Ackerman, former vice-president and general manager of the United States Light & Heat Company, and C. C. Bradford, sales manager of the same company. The company was formed to represent manufacturers of electrical apparatus and automobile and railway supplies for domestic and foreign trade.

New Zealand Wants Electrical Conduit.—Jobbers in New Zealand have experienced difficulties recently in obtaining enough electrical conduit from England, according to the United States Commerce Reports. They are interested in American sources of supply and have asked about the possibility of manufacturers in the United States making conduits in accordance with the local standards. Brazed or welded heavy-gauge conduit is commonly used, made up with threaded joints. The North Island has a wider use for the brazed joint, while in the South Island the welded is more popular. As the conduit used here is of lighter weight than that used in the United States, a finer thread is employed. Rating is by the external diameter, and not internal. The 0.625-inch has the most extensive use, as the smaller over-all diameter of English rubber-covered wire makes a 0.625-inch measurement satisfactory for small installations. An American company is furnishing some dies to a local jobber to cut these threads, so that there should be no difficulty in obtaining the proper tools for this purpose. According to reports from local dealers brazed-joint ⅝-inch enameled heavy-gauge conduit costs now about 12 shillings ($2.92) per 100 feet f.o.b. English ports.

Electricity Drives World's Largest Crusher.—To bring out the wide range of uses and the approaching universal adoption of electricity for power it is interesting to note that the world's largest gyratory crusher is operated by an electric motor. The crusher was recently installed by the Kennedy-Van Saun Manufacturing & Engineering Corporation, New York, at the plant of the Michigan Limestone & Chemical Company, Rogers, Mich. This No. 60 crusher has a capacity of approximately 25,000 tons per 20-hour day crushing limestone from a maximum size, which will enter its receiving openings, having a combined area of 60.5 inches by about 35 feet down to about 8 inch and finer, which is the largest ever built anywhere in the world. The main shaft is about 3 feet in diameter at its largest portion and about 28 feet long. The total height of the machine is 34 feet. It is driven with 12/5-inch manila ropes by a 66-inch cast steel sheaves, having 18 machined rope grooves. It is operated by the English system, so, if as many as half of the ropes should fail from wear, the crusher can still serve. The source of power is a 300-horsepower motor, which has been found ample for the requirements. The average power consumption, however, is about 150 horsepower and peak loads 200 horsepower. The idea in using a larger motor was so that if the crusher had to be shut down, there would be sufficient extra power with which to start it without removing the stone from the crusher.

LATEST APPROVED FITTINGS

The electrical fittings illustrated and described in this department have been approved by the Underwriters' Laboratories, Incorporated, after examination and tests conducted under standard of the National Electric Code as recommended by the National Fire Protection Association

CABINETS AND CUTOUT BOXES. Riddle Sheet Metal Works, San Francisco, Cal.
Listed January 29, 1917.

CLEANING MACHINES.—Vehicle Specialty Company, Hartford, Conn.
Illuminated, overhead, vehicle washer. "Rhodes."
Listed February 2, 1917.

CONDUIT BOXES, Fittings for.—Appleton Electric Company, 218 N. Jefferson Street, Chicago, Ill.
Stamped steel conduit-box covers, with single metal or porcelain-bushed hole for pendant or reinforced flexible cord. Catalog Nos. 8302, 8302A, 8402, 8402A, 8463, 8463A.
Listed February 7, 1917.

CONDUIT BOXES, Fittings for.—Cameron Overbagh, Chicago, Ill.
Supports for conduit boxes, each consisting of a formed slotted steel bar with holes for mounting; steel tongued hickory with 0.375 inch pipe threads and 0.25 inch steel screw and nut. Boxes are secured on hickeys clamped against bar. Designed for mounting conduit boxes on joists, etc., in hollow walls and ceilings. "DCO."
Meter fittings consisting of porcelain terminal block, steel base plate for securing in standard conduit box and pressed steel cover, all designed to be adapted to a standard conduit box four inches square, 1.5 inches deep, for making connection in service meter. "CO."
Listed January 16, 1917.

CURRENT TAPS.—Cutler-Hammer Manufacturing Company, Milwaukee, Wis.
"C-H" multiple type, keyless, 660 watts, 250 volts, catalog No. 7708.
Listed February 7, 1917.

ELEVATOR CONTROL APPLIANCE.—Chicago Safety Appliance Company, 208 S. La Salle Street, Chicago, Ill.
Elevator control system, consisting of elevator door switches connected in series with controller in car. Emergency switch in car is provided to shut out door switches in case they fail to operate.
Listed December 21, 1916.

ELEVATOR CONTROL APPLIANCE.—Schweitzer & Conrad, Incorporated, 4431 E. Ravenswood Avenue, Chicago, Ill.
Reverse-phase relay consisting of solenoid coil core which carries contacts by which line is short-circuited in case of a change in phase relation in circuit, thereby causing fuses in circuit to blow. Core and contacts are enclosed in sheet-steel cabinet. For use with alternating-current elevator-motor equipment. "Schweitzer." 50 amperes, 250 volts, alternating current.
Listed January 11, 1917.

FIXTURE FITTINGS. — George Cutter Company, South Bend, Ind.
Reflector holders inclosing standard sockets of medium and mogul-base types, for use with Cutter "Sol-Lux" industrial lighting reflectors. "Cutter," catalog Nos. 30502-07.
Listed December 14, 1916.

FIXTURES. — Sprague Electric Works of General Electric Company, New York, N. Y.
Exit light fixtures consisting of cast-iron conduit box enclosing double-ended-porcelain receptacles; box cover provided with openings spelling "Exit;" openings being covered by sheet of ruby glass attached to back of cover, but slightly separated therefrom to provide ventilation. "S" three, four, five-inch letter.
Listed February 2, 1917.

FIXTURES, Electric and Combination.—Engelberg & Bear, Richmond, Va.
Listed January 9, 1916.

FIXTURES, Electric and Combination.—The Kavline Company, 312 High Avenue, Cleveland, O.
Listed January 31, 1917.

FIXTURES, Electric and Combination.—St. Louis Brass Manufacturing Company, St. Louis, Mo.
Listed February 6, 1917.

FUSELESS ROSETTES. — General Electric Company, Schenectady, N. Y.
"G. E." Rosettes with pull socket mechanisms. Three amperes, 125 volts; one ampere, 250 volts; catalog Nos. GE666-73 inclusive, GE677-78, three amperes, 250 volts; catalog Nos. 39235, 39237, 39239, 43111, 59807-09 inclusive, 65963, 66678, GE429-30.
Listed February 5, 1917.

FUSES, CARTRIDGE. — Chelten Electric Company, 314 Armat Street, Philadelphia, Pa.
Cartridge enclosed fuses. "Chelten Electric Company," 0-600 amperes, 250 volts.
Listed January 25, 1917.

HEATERS—BATH CABINETS.—Frank S. Betz Company, Hammond, Ind.
Metal cabinet provided with doors at top and front. The interior is lined with reflecting material and is equipped with receptacles for incandescent lamps arranged in circuits and controlled by switches and cutouts placed on outside of cabinets. Special terminal is provided for ground wire. Designed for medical heat and light bath treatment of persons. Twenty amperes, 220 volts. Type 9 N2063.
Listed February 2, 1917.

HEATERS—BATH CABINETS.—Federal-Guber Company, Halsted and Fulton Streets, Chicago, Ill.
Marble cabinet provided with doors at top and front. The interior is equipped with receptacles for incandescent lamps arranged in circuits and controlled by switches and cutouts placed on outside of cabinets. Special terminal is provided for ground wire. Designed for medical heat and light bath treatment of persons. 2,800 watts, 125 volts, "F. H. Co."
Listed February 2, 1917.

HEATERS—BATH CABINETS.—Burdick Cabinet Company, Milton, Wis.
Metal cabinet provided with doors at top and front. The interior is lined with reflecting material and is equipped with receptacles for incandescent lamps arranged in circuits and controlled by switches and cutouts placed on outside of cabinets. Special terminal is provided for ground wire. Designed for medical heat and light bath treatment of persons, 3,000 watts, or less, 125 volts. Types A, B, C, D.
Listed February 2, 1917.

HEATERS—BATH CABINETS.—J. L. Mott Company, Trenton, N. J.
Metal-lined wood cabinet provided with doors at top and front. The interior is lined with reflecting material and equipped with receptacles for incandescent lamps arranged in circuits and controlled by switches and cutouts placed on outside of cabinets. Special terminal is provided for ground wire. Designed for medical heat and light bath treatment of persons, 4,000 watts, or less, 250 volts. "J. L. Mott Company."
Listed February 2, 1917.

INSULATING DEVICES—FIBER STOPS.—H. C. Brandt, New Orleans, La.
Fiber stop consisting of round disk of red fiber three-quarters inch in diameter, slotted on one side. For use where under rules of National Electrical Code insulating tubes must be fastened at ends to prevent them from moving along wires.
Listed February 2, 1917.

INSULATING MATERIALS. — C. P. Lovering Company, Ellenboro, W. Va.
Mouldable insulating materials having the following properties: Practically non-absorptive; slightly brittle; not strictly non-combustible; moderate dielectric strength; "Condensite" not noticeably affected by and "No. 1 Composition" slightly affected by temperature of 400 degrees Fahrenheit; unaffected by acids or oils; and easily worked with tools.
"Condensite." "No. 1 Composition." These materials are judged to be suitable for parts of electrical devices requiring these properties. Manufacturers of such devices desiring to use these materials should submit samples in commercial form for examination and test by Underwriters' Laboratories.
Listed February 10, 1917.

PERSONAL AND BIOGRAPHICAL

MR. WILLIAM HASKINS has been appointed superintendent of the light and water plant at Shoals, Ind.

MR. EMIL A. BECHSTEIN, general manager of the Sandusky Gas & Electric Company, Sandusky, O., has recently been elected second vice-president of the company.

MR. B. L. AAGE was appointed general auditor of the American Public Utilities Company, effective January 1, 1917, with his office at Grand Rapids, Mich.

MR. M. B. WHEELER will be appointed commercial agent of the American Public Utilities Company, effective March 1, 1917, with his office at Grand Rapids, Mich.

MR. F. R. COATES, president of the Toledo Railways & Light Company, was made a director of the Toledo Traction, Light & Power Company, at its recent annual meeting.

MR. WILLIAM SCHARENBURG has been made manager of the Columbus, O., branch of the Avery & Loeb Electrical Company. This branch was recently secured by the buying of the Columbus Chandelier Company by the Avery & Loeb Electrical Company.

MR. F. E. McKENNA, local manager of the Oregon Power Company at Coquille, Ore., has been appointed a member of the Board of Directors of the Commercial Club of Coquille.

MR. C. E. FAHRNEY, manager of the Ottumwa Railway & Light Company, Ottumwa, Iowa, has been appointed chairman of a committee to find situations for the guardsmen who are returning from the border.

MR. J. H. CALHOUN, formerly manager of the Hillsboro, Texas, district of the Texas Power & Light Company, has been appointed manager of the company's properties at Tyler, Texas, to succeed Mr. L. S. Small, resigned. Mr. Small has accepted a similar position at Concordia, Kans.

MR. LOUIS D. GIBBS, superintendent of advertising for the Boston Edison Company, has been elected a member of the advisory committee of the Department of Arts and Sciences, Oberlin College, Oberlin, Ohio. He recently addressed the student body of this, his alma mater, on "Opportunities in Business for the College Man."

MR. P. A. STAPLE has been elected vice-president and general manager of the Binghamton Light, Heat & Power Company, Binghamton, N. Y. He was formerly second vice-president of the Sandusky Gas & Electric Company, at Sandusky, O.

MR. J. P. SPEAR, of the General Electric Company, gave an interesting address on "Electric Storage Batteries" recently, before the members of the Electric Club, Trenton, N. J.

MR. CHARLES J. MARSH at the January meeting of the board of directors of the Standard Underground Cable Company, was elected vice-president. He has for many years been manager of the eastern and northeastern sales departments and also principal eastern metal buyer, with headquarters in New York. He will continue to have his headquarters in New York and to exercise general supervision over this sales territory.

MR. GEORGE A. WARDLAW, who became editor of the *Electrical Record* in 1910, has resigned that position. The resignaiton took effect March 1. Previous to his connection with the *Electrical Record* Mr. Wardlaw was editor of the *Transactions* of the American Institute of Electrical Engineers. In the future Mr. Wardlaw will be engaged in business for himself in the free-lance literary field.

MR. ERNEST M'CLEARY, of Detroit, Mich., was elected first vice-president of the National Association of Builders' Exchanges at a recent meeting of the Association in Atlanta, Ga. Mr. McCleary is a member of the Detroit Builders and Traders' Exchange and has been very prominent in the electrical field for a great many years. From 1903 to 1905 he was president of the National Electrical Contractors' Association. In this capacity he was exceptionally active and because of his vast experience in the formulating

Mr. Ernest M'Cleary.

of codes he was named to serve on the National Code Committee of the Electrical Contractors' Association.

MR. W. C. DUNCAN, formerly in charge of the Waco, Texas commercial department of the Texas Power & Light Company, has been appointed manager of the Hillsboro, Texas, district of the company and will have charge of Hillsboro as well as the towns of West, Itasca, Milford, Frost, Malone, Abbott, Irene, Brandon and Mertens. Mr. Duncan began work with the company as a salesman at Paris, having formerly been with the Public Service Company at Bay City, Texas. He was later transferred to Waco and later was given the Hillsboro position.

DR. MICHAEL I. PUPIN, noted scientist and professor of electromechanics at the University of Columbia, New York City, was recently honored by a dinner given in celebration of his having completed 25 years of remarkable work in the electrical field. Dr. Pupin came to this country as a Serbian emigrant. At the dinner which was attended by 350 students from the University, he was introduced by Mayor Mitchell of New York City, who presided at the dinner as toastmaster.

MR. H. O. SWOBODA, consulting engineer, Pittsburgh, Pa, gave an illustrated lecture before the Technical Society of Pittsburgh, on February 14. The title was "Modern Electric Street Lighting." Mr. Swoboda first traced the evolution of electric street lighting and then discussed the various advantages and disadvantages of incandescent and arc lamps of the modern types. A strong plea was made for more attractive and efficient street lighting.

MR. J. E. DAVIDSON has been appointed to take active charge of the administration of the Omaha Electric Light & Power Company, Omaha, Neb. He was formerly vice-president and general manager of the Pacific Power & Light Company, Portland, Ore., and resigned this position to take on his present duties. He went to Portland in 1910 to become business manager of the Pacific Power & Light Company, which owns a string of plants in the Columbia river basin. He was advanced to general manager and later assumed additional responsibilities as vice-president. He had charge of operating, engineering, new business and purchasing matters. In 1911 he became president of the Northwest Electric Light & Power Association. At a meeting of the National Electric Light Association at San Francisco in 1915, he was elected to the executive committee.

OBITUARY.

COLONEL CURTIS V. HARD, president of the Wooster Electric Company, Wooster, O., died at his home recently from the effects of a stroke of paralysis. It was the third stroke he had had within a few months.

MR. HENRY D. TEMPLE, an electrical contractor of Worcester, Mass., died at the Homeopathic Hospital, Boston, February 19, aged 44 years. He was a graduate of the Worcester Polytechnic Institute, class of 1895, and had been in the contracting business 17 years, during which he had wired a large number of public buildings and blocks in central Massachusetts. Mr. Temple was secretary of the Massachusetts Electrical Contractors' Association from the time it was organized in 1903 until last year.

MR. JOHN J. BURLEIGH, vice-president of the Public Service Corporation of New Jersey and president of the Broadway Trust Company of Camden, N. J., died February 18, at his home in Merchantsville, N. J., at the age of 63 years. He was born in Elmer, N. J., and worked up from the position of telegraph operator, which he held at 14 years of age, to the position of trainmaster of the West Jersey Railroad of the Pennsylvania System. Later Mr. Burleigh built the first telephone and electric street railway systems of New Jersey.

CURRENT ELECTRICAL NEWS

Weekly Record of Construction Activities

Advance Information Gathered from Every Section of the Country Showing the Extent of Spring Construction Work to Be Undertaken by Electric Light and Power, Electric Railway, Telephone and Telegraph and Industrial Corporations of Every Description

EASTERN STATES.

CARIBOU, ME.—An act to authorize the town of Caribou to acquire the property of the Caribou Water, Light & Power Company and to construct and maintain for itself and for persons and corporations, is now before the state legislature.

DAMARISCOTTA, ME.—The plant of the Portland Power & Development Company here is being operated under a contract for one year, with provision that it be improved in efficiency and put on a firm financial basis, by the Lincoln Electric Company, Waterville, Me. The plant, which is now operated in connection with two industrial works, will be rearranged, new equipment added to make it a duplicate plant, and transmission lines improved by the substitution of new insulators.

FRANKLIN, N. H.—The city's contract with the Franklin Light & Power Company has expired, and negotiations are now under way for the drawing up of a new contract. In connection with the new contract, H. E. Clifford, of Harvard University, is making investigations relative to a new street-lighting system.

FORESTDALE, VT.—The new power plant for this city is being completed, and the city will probably soon be ready to undertake other electrical work in connection with the consuming of the power produced.

RUTLAND, VT.—Business of the Rutland Railway, Light & Power Company for 1916 showed considerable increases over 1915. A new 13,500-volt line is being built to connect with the line of the Western Vermont Power & Light Company, a subsidiary.

AMESBURY, MASS.—The Amesbury Electric Light Company has petitioned the Massachusetts Gas & Electric Light Commission for authorization of an issue of 750 shares of new capital stock at $135 per share, the proceeds to pay for extensions and improvements now going forward.

BOSTON, MASS.—Among the Boston Edison Company's additions to its plant to be made during the coming year are the building and equipment of two substations and the installation of two 30,000-kilowatt turbogenerators in the L Street (principal) generating station.

BROCKTON, MASS.—Edison Electric Illuminating Company, A. F. Nelson, general manager, has under way of construction an addition to its power station and a new substation in this city. Later a combination underground and overhead, 2,200-volt line will be built in this city and some extensions in towns served by this company will be made.

CHICOPEE, MASS.—The city intends to construct a new substation of 3,750-kilovolt-amperes capacity, to connect with the line of the Turner Falls Power & Electric Company. This will be an outdoor substation, and work will be started at an early date. An extension will be made to supply a rather distant consumer with a load of 1,000 kilowatts. Changes are being made in the city street lighting systems.

DANA, MASS.—Electric lighting for this town is being considered. Energy may be purchased from the New England Power Company, Worcester, Mass.

FALL RIVER, MASS.—The capacity of the Fall River Electric Company's plant will be increased during the coming summer to 15,250 kilowatts by the addition of a 6,250-kilowatt, General Electric turbogenerator. A 66,000-volt, double-circuit, steel-tower transmission line will be erected during the year, connecting the company's steam station with the lines of the New England Power Company at East Providence, R. I. In connection with this line a substation will be built on Taunton River on the Fall River side. In this substation three 5,000-kilowatt-ampere transformers will be installed. For the main part of the new high-tension line 76-foot towers will be used, and when the line crosses the river 240-foot towers will be used. An extension, 10 miles long, is being considered which will connect with Dighton, Mass. The company will continue to replace direct-current systems with alternating current during the coming year.

TRUMBULL, MASS.—The improvement society of this city is contemplating the installation of new street lights.

AUBURN, N. Y.—The Empire Gas & Electric Company, Louis C. Reynolds, general superintendent, will install a 2,000 kilovolt-ampere synchronous condenser for power factor connections at its plant in this city, as well as its plant in Geneva. In its substation 10 three-phase automatic-feeder regulators will be installed and a water power will be developed on the Canandaigua Outlet at Lyons, capacity 500 kilowatts. The company's 10,000-kilowatt hydroelectric plant on Seneca River is about completed. This additional source of power will probably call for many new installations by consumers in the district.

NEW YORK, N. Y.—The Interborough Company has made application to the Public Service Commission for permission to issue bonds for $16,436,000 for extensions of its system, equipment and stations. The proposed work includes $10,444,000 for the construction of third-rail tracking and equipment; $2,533,000 for extensions and equipment, and $2,391,000 for extensions and improvements in power stations.

ROOSEVELT, N. Y.—The City Council is taking up the question of purchasing additional street lights for the city.

WALDEN, N. Y.—The Public Service Commission has approved of the exercise of franchises for electric lines in the towns of Montgomery and Crawford, Orange County, by the Wallkill Valley Electric Light & Power Company.

BORDERTOWN, N. J.—At the Public Service Electric Company's substation in this city three 1,000-kilovolt-ampere transformers; two 500-kilowatt motor-generator sets and a 26,400-volt line equipment are to be installed during this year. N. A. Carle, Newark, N. J., is chief engineer.

BURLINGTON, N. J.—The Public Service Electric Company, N. A. Carle, Newark, N. J., chief engineer intends to install two 11,500-kilovolt-ampere transmission transformers; two 26,400-volt arrester equipments and besides this will make additions to its steam-power plant in connection with its station in this city.

CAMDEN, N. J.—At the Atlantic Avenue substation, belonging to the Public Service Electric Company, Newark, N. J., a 26,400-volt line equipment and 1,000-kilowatt motor-generator set will be installed during this year. At the Camden station, belonging to the same company, two jet condensers and six motor-driven blowers and ducts will be installed. N. A. Carle, Newark, N. J., is chief engineer.

CARTERET, N. J.—At the substation of the Public Service Electric Company, Newark, N. J., located in this city, a 4,000-kilovolt-ampere transmission transformer and a 26,400-volt arrester equipment will be installed during 1917. N. A. Carle, Newark, N. J., is chief engineer.

FORDS, N. J.—The Public Service Electric Company will install a street-lighting system in the Fairfield Terrace section.

HACKENSACK, N. J.—The Public Service Electric Company intends to install two 26,400-volt line equipments and arresters in its substation located in this city. N. A. Carle, Newark, N. J., is chief engineer.

JERSEY CITY, N. J.—The Morgan Street substation in this city is to have a 3,000-kilovolt-ampere transformer and equipment installed during this year. This substation belongs to the Public Service Electric Company, Newark, N. J., of which company N. A. Carle is chief engineer.

JERSEY CITY, N. J.—The Ocean Avenue Business Men's Association is negotiating with the City Commission for the installation of a street-lighting system along Ocean Avenue in the Greenville district.

METUCSEN, N. J.—The Public Service Electric Company, N. A. Carle, Newark, N. J., chief engineer, will install four 26,400-volt line equipments at its station in this city.

MONTCLAIR, N. J.—At the substation of the Public Service Electric Company, Newark, N. J., located in this city, an addition will be made to the substation building and one 3,000-kilovolt-ampere transformer will be installed. N. A. Carle, Newark, N. J., is chief engineer of the company.

NEWARK, N. J.—The Public Service Electric Company, of this city, intends to make the following installation during the year at its Essex station: One 35,000-kilowatt turbogenerator and equipment; additions to the boiler house; additions to the switch house; two 11,500-kilovolt-ampere transmission transformers; equipment for a 26,400-volt arrester. At the Plank Road substation the company intends to make some additions. N. A. Carle is chief engineer.

PASSAIC, N. J.—A 26,400-volt line equipment is to be installed at the substation in this city, which is owned by the Public Service Electric Company, N. A. Carle, Newark, N. J., chief engineer.

PERTH AMBOY, N. J.—At the Public Service Electric Company's station in this city the following installations will be made during the year: One 3,000-kilovolt-ampere transformer; three 26,400-volt line equipments and arresters, and two 11,500-kilovolt-ampere transmission transformers. N. A. Carle, Newark, N. J., is chief engineer.

PERTH AMBOY, N. J.—The board of aldermen is considering the installation of 22 electric lamps, to form a street-lighting system on Smith Street, between State and High Streets.

ROOSEVELT, N. J.—The council is considering the installation of a municipal electric plant. The Public Service Electric Company has recently submitted a bid for the installation of proposed new street lights at $13.95 each.

RUTHERFORD, N. J.—A 3,000-kilovolt-ampere transformer is to be installed in the substation in this city, which is a part of the system of the Public Service Electric Company, Newark, N. J. N. A. Carle, Newark, N. J., is chief engineer.

TRENTON, N. J.—At the Olden Avenue substation, which belongs to the Public Service Electric Company, of Newark, N. J., a 3,000-kilovolt-ampere transformer and equipment is to be installed, and at Liberty Street substation two 26,400-volt line equipment with arresters and two 8,000-kilovolt-ampere transmission transformers are to be installed during this year. N. A. Carle, Newark, N. J., is chief engineer.

WEEHAWKEN, N. J.—The Union Hill Retail Merchants' Association and other local organizations are preparing a petition to be presented to the Board of Public Utility Commissioners, providing for the

removal of the present overhead, high-tension lines of the Public Service Electric Company, in the North Hudson district, and the installation of an underground system.

WOODBURY, N. J.—The borough council is considering the installation of an electric street-lighting system at Woodbury Heights, to replace the present gas lamps.

PHILADELPHIA, PA.—At a cost of $300,000 the Philadelphia Electric Company has started the construction of a high-tension cable line which is to carry power between this city and Chester. This project is a part of the company's program for increasing its electric power production, the financial end of which resulted in the company increasing its capital from $57,000,000 to $110,000,000 in its recent refinancing plan. The high-tension line will connect the local power house with the plant of the Beacon Light Company, now under construction in South Chester. The Beacon Light Company is a subsidiary of the Philadelphia Electric. The entire development undertaken in Chester, including the connection with this city, will aggregate an expenditure of $6,000,000.

READING, PA.—It has been proposed to electrify the Reading Railway for a distance of 37 miles from Pottsville, Pa., to this city. The cost will be about $750,000.

SOUTH BETHLEHEM, PA.—Business men on Second and Third Streets are raising a fund of $15,000 for the installation of a boulevard street-lighting system on these thoroughfares.

GREENWOOD, DEL.—The Cranston Lumber Company has acquired the electric plant formerly operated by C. F. Warrington, and is reported to be planning for improvements.

WILMINGTON, DEL.—The street department is considering the installation of a street-lighting system on a portion of King Street.

BLUEFIELD, W. VA. — Appalachian Power Company intends to construct a considerable mileage of transmission line during the coming year, though definite plans have not yet been completed for all of the work. Twenty-six miles of 88,000-volt transmission line are now being put up, and it has been definitely decided to run 20 miles of 13,000 volt line immediately.

CLIFTON, W. VA.—The J. G. White Engineering Company has been awarded a contract for the erection and installation of a steam power plant for the Virginia-Western Power Company at Clifton.

HUNTINGTON, W. VA.—Consolidated Light, Heat & Power Company, W. R. Power, general manager, intends to install a 10,000-horsepower turbine complete with condensers in its plant at Kenova, W. Va. The company will also install a pumping plant at the Big Sandy River, and a high-tension line is now being completed from Kenova to Ironton, a distance of 12 miles.

LOGAN, W. VA.—The Logan County Light & Power Company, a subsidiary of the General Utilities & Operating Company, F. R. Weller, Washington, D. C., vice-president, will increase its power plant during the coming year by the addition of a 5,000-kilovolt-ampere turbine. The building extension will be 50 by 102.5 feet and 50 feet high, and will be constructed of a steel frame with brick walls and a concrete roof. This company will also build about 25 miles of 44,000-volt transmission line.

WHEELING, W. VA.—Sunnyside Electric Company intends to extend 66,000-volt lines on wooden poles with suspension type insulators, as follows: Dillonvale, O., to Amsterdam, O., 23 miles, and Fairpoint, O., to Flushing O., nine miles. Besides this it is stated that the company will probably construct several short extensions, of from one to four miles, to supply power for coal mines in the districts which its serves.

WHEELING, W. Va.—A 66,000-volt transmission line will be built during the coming year by the Wheeling Electric Company from Wheeling to Windsor, a distance of 12 miles. The company is now constructing a 66,000-volt line from Wheeling to Moundsville, a distance of 10 miles. Fred B. Garden is general manager.

AMERICUS, GA.—An addition of a 625-kilovolt-ampere turbine and condenser will be made at the plant of the Americus Lighting Company, which is a subsidiary of the General Utilities & Operating Company, F. R. Weller, vice-president, Washington, D. C.

AMERICUS, GA.—A company has been organized by L. G. Council, Frank Lanier and others, which has purchased the electric lighting plant of the Americus Public Service Company.

NORMAN PARK, GA.—The Norman institute has plans for the installation of a lighting plant.

STARBORO, GA.—It is said that $60,000 in bonds have been voted for improving the electric-light plant.

TENNVILLE, GA.—At a recent election the city voted to install a lighting plant.

VALDOSTA, GA.—Extensive improvements are planned by the Valdosta lighting plant, including enlargement and the installation of a refrigerating plant. The cost will be about $100,000.

DATES AHEAD.

Wisconsin Electrical Association. Annual meeting, Hotel Pfister, Milwaukee, Wis., March 15-16. President, W. E. Haseltine, Ripon, Wis.

Minnesota Electrical Association. Annual convention, St. Paul, Minn., March 20-22. Secretary, Fred A. Otto.

National Association of Electrical Inspectors. Biennial convention. New York, March 27-29. Chairman committee on arrangements, Alfred E. Braddell, Sprague Electric Co., New York City.

Tri-State Water and Light Association of the Carolinas and Georgia. Annual convention, Macon, Ga., April 17-19. Secretary, W. F. Steiglitz, Columbia, S. C.

Southwestern Electrical and Gas Association. Annual convention, Dallas, Tex., April 26-28. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Tex.

National Fire Protection Association. Annual meeting, Washington, D. C., May 8-10. Secretary-treasurer, Franklin H. Wentworth, 87 Milk Street, Boston, Mass.

Arkansas Association of Public Utility Operators. Annual convention, Pine Bluff, May 16-18. Secretary-treasurer, R. B. Fowles, Pine Bluff Company, Pine Bluff, Ark.

Electrical Supply Jobbers' Associations. Semi-annual meeting, Homestead Hotel, Hot Springs, Va., May 22-24. Secretary, Franklin Overbagh, 411 South Carolina Street, Chicago, Ill.

National Electric Light Association, Iowa Section's annual convention, Des Moines, Iowa, May 24-25. Secretary, L. E. Caldwell, Iowa City, Iowa.

National Electric Light Association. Annual convention, Atlantic City, N. J., May 29-June 1. Secretary, T. C. Martin, 29 West Thirty-ninth Street, New York City.

American Institute of Electrical Engineers. Annual convention. Hot Springs, Va., June 26-29. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York City.

NORTH CENTRAL STATES.

AKRON, O.—At the Gorge power house and the substation on the Northern Division new installations are now being made, including two 20,000-kilowatt turbogenerators, boilers of 6,000-horsepower capacity and nine 1,000-kilowatt, 60-cycle rotary converters. The addition of this power will undoubtedly later call for further electrical installations. At Canton, O., three 1,000-kilowatt rotary converters will be installed. A new substation will be built at East Akron, and it will receive electricity from a 22,000-volt line, and will have one 1,000-kilowatt rotary converter and two 1,000-kilowatt distribution transformers. At Kenmore, O., a high-tension switching station will be built, with a capacity for handling 10 22,000-volt circuits. A number of changes will also be made at some of the other important substations of this company. The above plants are a part of the system of the Northern Ohio Traction & Light Company. L. G. Tighl, superintendent, electrical department.

CANTON, O.—The Council will extend the electric lighting on Broad Avenue, from Fourth to Twelfth Street. The electric lamps will be mounted on ornamental iron posts. Address Henry A. Schrantz, president of the Council.

CINCINNATI, O.—A new power house of 125,000 kilovolt-amperes capacity is being built by the Union Gas & Electric Company, Mr. De Forest, electrical engineer. This plant will generate electricity at 13,200 volts, and the company is going to construct a new transmission system, in specially constructed ducts, to all of its substations. Most of the cable used in this system will be three-conductor, 350,000 and 400,000 circular mills in size. The cable will be run through the high-water district in a specially constructed conduit system. As regards this system special precautions will be taken for drainage, washing ducts after a flood, packing the cables where they come out of the duct into the manhole, and making the manhole covers water tight. In the direct-current substations 3,500-kilowatt rotary transformers and in the alternating-current substations 2,000-kilowatt. air-cooled transformers will be used. A transmission line is now being constructed by the company to Hamilton, O., where it will feed on up as far as Middletown, O.

CLEVELAND, O.—Light Commissioner Davis has reported that the municipal-lighting plant is not sufficiently large to take care of the electrical-power needs of the city, and is thereby causing a loss of $106,000 per year.

COLUMBUS, O.—A new power house, new cars and general improvement of its service and facilities are included in plans of the Columbus Railway, Power & Light Co. The company has filed with the Public Utilities Commission an application for authorty to issue securities to the extent of $1,640,379. These extensions and improvements are proposed: New power house, at an estimated cost of $1,000,000; extension of power and lighting systems; construction of new transmission lines connecting new power house with distributing system.

LORAIN, O.—Plans to build an electric plant, the construction of which will cost in the neighborhood of $500,000, have been fully decided upon by the Lorain County Electric Company, now operating an electric plant on the lake shore.

MILFORD, O.—The present franchise for the electric lighting of this city will expire in April, and the city's light committee is considering various new lights with the idea of putting in a better lighting system for the city when the new franchise is given.

NEW CONCORD, O.—The plant and franchise of the New Concord Water & Electric Company has been sold to an unannounced buyer, by S. V. Thompson & Company, which company is now also negotiating for the purchase of the municipal plant. The sale was made for $37,000.

SPRINGFIELD, O.—It has been decided on, by the Springfield Light Heat & Power Company, to spend approximately $20,000 in the laying of underground cables. Several additions will be made in the boiler room of the company's plant, and a high-tension substation will be erected and a 3,000-kilovolt-ampere transformer installed. It is stated that many extensions will be made to the transmission line of the company, in order to take care of its increasing business. Weary Parsons is general manager.

GOSHEN, IND.—The Hawks Electric Co., of Goshen has filed with the Nappanee Town Board of Trustees a proposition for the purchase of the Nappanee lighting plant, which is owned by the town. Plans have been made for re-equipping the concern, but some taxpayers are in favor of selling the property. Owen Cover is general manager of the Hawks company.

INDIANAPOLIS, IND. — Construction work has been started by the Indianapolis Light & Heat Company on a new power plant, located in this city, at Kentucky Avenue and South Street. That part of the plant which will be completed during this year will be sufficiently large for housing 10/1,000-horsepower boilers, two 20,000-kilowatt horizontal turbines with surface condensers and other auxiliary apparatus. In connection with this plant a 15,000-ton, under-water storage pit for coal will be built. Work has been started, but as yet all of the contracts have not been let. Several other installations have just been completed by the company, which will tend toward a considerable increase in power supply for this city. A substation with a 1,000-kilowatt motor-generator set has been completed and a 15,000-kilowatt turbo-generator installed at the Mill Street station. Thomas A. Wynne is vice-president.

INDIANAPOLIS, IND.—Senator Andrew H. Beardsley, of Elkhart, Ind., fosters a plan to establish an indirect lighting system in the senate chamber, and believes he can realize his plan by having an amendment attached to the present senate bill for an adequate ventilating system in both legislative houses.

RICHMOND, IND.—About $50,000 is to be expended on improvements which are to be made to the Richmond municipal electric plant.

CHICAGO, ILL.—Plans for work during the coming year by the Commonwealth Edison Company, Louis A. Ferguson, vice-president, will consist of two additional units at the Northwest station. One will be a 30,000-kilowatt, 12,000-volt, 60-cycle turbogenerator, and the other a 35,000-kilowatt, 9,000-volt, 25-cycle turbogenerator. At substations the company is adding a total of 10,000 kilowatts in 250-volt synchronous converters for the direct current district, a total of 30,000 kilowatts in 60-cycle transformers for other substations and 18,000 kilowatts in synchronous converters in railway substations. Extensions to the company's outside plant will be determined by the new business obtained, but will probably be as much as during the past year.

DANVILLE, ILL.—Contracts have been let by the Danville Street Railway & Light Company for the installation of a 4,000-kilowatt, condensing turbine unit. The new building for this equipment has been nearly completed, and a substation will be built to take care of the transmission lines leaving this plant. The company is a subsidiary of the Illinois Traction System, E. S. Hight, chief operating engineer, Peoria, Ill.

DECATUR, ILL.—The city intends to do considerable during the coming year in the way of improving its street lighting system, and a new transmission line 2,300 volts, will be erected from the power plant to the central part of the city. William L. Rice is chief city electrician.

LA SALLE, ILL.—The question of issuing $23,000 in light and water improvement bonds will be submitted to vote March 20.

ORION, ILL.—The electric-lighting plant has been sold to D. M. Bowen, of Sherrard. Bowen expects to use the local plant as a supply station for neighboring towns and farmers. A new engine will be installed and continuous service had not later than June 1.

OTTAWA, ILL.—Work has just been started by the Northern Illinois Light & Traction Company to construct a plant with a 4,000-kilowatt turbine generator. In connection with this plant an outdoor transformer station will also be built. The company is controlled by the Illinois Traction System, Peoria, Ill., and E. S. Hight, Peoria, Ill., is chief operating engineer for the entire system.

PEKIN, ILL.—The Board of Local Improvements plan to establish ornamental-lighting in several streets.

PEORIA, ILL.—The Central Illinois Light Company certified to the secretary of state to an increase of capital stock from $5,500,000 to $20,000,000. Enlargements of plants and the necessity of purchasing additional equipment to take care of increasing business made the issuing of additional stock necessary. Address General Manager, 316 South Jefferson Avenue, Peoria, Ill.

ROBERTS, ILL.—The citizens have voted to have the present lighting plant enlarged.

ROCKFORD, ILL.—The Rockford Electric Company expects to replace its 2,000-kilowatt turbine generator with a new 12,500-kilovolt-ampere Curtis turbine. Two 75-horsepower Stirling boilers will be installed, and the question of making a 15,000-ton coal pit at a cost of $75,000 is being considered. It is estimated that the company will spend $98,000 during the year for extensions and other work on its distributing system. Adam Gschwindt is general manager.

BOYNE, MICH.—Plans for reorganization of the Boyne City, Gaylord & Alpena Railway Company have been started and the construction of a line between Alpena and Atlanta, Mich., is expected.

LOWELL, MICH.—Bonds have been voted in this city to the extent of $40,000, and this money will be used in rebuilding the city's electric-light plant.

LUDINGTON, MICH.—The Commonwealth Power, Railway & Light Company, New York, has purchased the Stearns Light & Power Company here, which furnishes light and power not only for Ludington, but also for Hart, Pentwater, Scottville and Custer.

MONROE, MICH.—The Toledo Railway & Light Company and the Detroit Edison Company are negotiating to buy the municipal plant of this city or get a long-time franchise, for operation, from the city.

PETOSKEY, MICH.—Extensive improvements in the municipally-owned light plant are now being planned by the city. The upper power dam will be discontinued, and the water flumed to the lower dam, where two wheels will be installed. The city also plans more street extensions and the use of more power machinery during the coming summer.

BELLEVILLE, WIS.—It is said that the electric-light plant in this city is to be sold and will then be remodeled. A new generator will probably be included in the remodeling program.

JUDA, WIS.—Charles Schwartzlow has about completed details and will start soon on the erection of an electric power plant to supply this city.

MANITOWOC, WIS.—It is said that the Wisconsin Securities Company, Milwaukee, Wis., intends to erect a new plant here, which will have an estimated cost of $500,000. The work will be done under the name of a subsidiary company, Wisconsin Public Service Company. Woodmansee & Davidson, First National Bank Building, Chicago, Ill., are engineers for the company.

MARION, WIS.—With the opening of spring the Marion Light & Power Company will build a modern brick building, 52 by 98 feet. Mr. Reiche is manager.

MILWAUKEE, WIS.—A. J. Sweet, consulting engineer, has submitted an offer to Mayor Hoan under which he agrees to supervise the completion of the municipal street-lighting system.

VIROQUA, WIS.—The Viroqua Electric Light Company has been purchased by a holding company. In the deal recently closed are the three plants of Viroqua, Sparta and Tomah. The power lines will be extended to these cities in the early spring. The new power company, it is said, will look for an outlet south of Viroqua.

WAUPACA, WIS.—E. A. Aspnes, of Montevideo, Minn., and Truman Hibbard, of Minneapolis, Minn., have become the owners of the Waupaca Electric Light & Railway Company. The amount involved is about $150,000. The purchasers propose to make improvements, especially in the electric light and power department of the utility.

BRICELYN, MINN.—Bricelyn is considering plans for an electric-lighting plant.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company, H. E. Young, sales manager, will put up about 200 miles of new line connecting many new towns with the company's system during the year. The company will also complete its 110,000-volt transmission line connecting with the lines of the Wisconsin-Minnesota Power Company at the new dam being built by this company at Chippewa Falls, Wis. This hydroelectric development will deliver about 40,000 horsepower, which amount has nearly all been contracted for by the Northern States Power Company, Chicago, Ill., and supplying current to this city. A number of the Minneapolis company's substations are to be enlarged during the year. The company's new terminal substation will be completed this spring, and will be capable of handling about 100,000 horsepower. The company's office building is also being remodeled, and this includes the company's substation, which is located in back of the offices.

ROCHESTER, MINN.—Engineer Hugh Cooper has recently presented to this city an extended report recommending the development of a hydroelectric power dam on the Zumbro River.

CEDAR RAPIDS, IOWA.—The Iowa Railway & Light Company has been granted a franchise for erecting and operating electric transmission lines to supply lamps, heaters and motors in Linn and Benton counties.

DES MOINES, IOWA.—Work is now in progress at the plant of the Des Moines Electric Company, which will raise distributing voltage from 2,300 to 4,000. In addition to this two boilers, 370 horsepower each, are being installed in connection with a 5,000-kilowatt turbine generator. This increase in capacity will undoubtedly call for additional electrical work in the area covered by this system. The company is controlled by the Illinois Traction System, E. S. Hight, chief operating engineer, Peoria, Ill.

DEXTER, IOWA.—An election will be held March 13 to consider granting a franchise to the Iowa Electric Company for the operation of an electric-lighting plant in this city.

EARLING, IOWA.—The Stinn Improvement Company contemplates extension and improvements to its plant, including a 35 horsepower, oil engine and a three-wire generator, 110 and 220 volts, and change its system from direct to alternating current. Address E. L. Stinn, engineer.

MARENGO, IOWA.—The Iowa Railway & Light Company has been granted a franchise to erect transmission lines in Washington, Johnson and Muscatine counties.

OROVILLE, IOWA.—Chief Engineer P. M. Downing of the Pacific Gas & Electric Company has been explaining the plans of his company for the betterment of the light service.

OSAGE, IOWA.—The Osage Electric Light, Heat & Power Company has been granted a franchise for street lighting. The company is in the market for 46 ornamental lamps and 6,000 feet of No. 8 double conductor cable. Address Thomas Ferris, manager.

SHEFFIELD, IOWA.—The Cedar Valley Electric Light Company has become owner of the Sheffield Light & Power Company. It is expected the Cedar Valley company will make some improvements on the local plant.

HANNIBAL, MO.—The North Missouri Light & Power Company, organized two years ago to furnish power from Keokuk Dam to light New London Center, Franklin and Perry, was purchased February 21 by the McKinley interests of St. Louis.

NEW LONDON, MO.—The stock and properties of the North Missouri Light & Power Company, valued at $60,000, have been sold in Hannibal, Mo., to the Illinois Traction Company. People believe the purchase of the plant is the first step toward the building of a north and south electric railroad through northeast Missouri by the Illinois Traction Company.

OREGON, MO.—The St. Joseph Transmission Company, Morton R. Martin, general manager, is now installing 30 miles of 33,000-volt, high-tension line which will be completed by April 1. Work will then immediately be started on the building of about 25 miles of 33,000-volt, 3-phase line. It is probable that in the near future an interurban railroad, now operating with gasoline, will be electrified and receive its power from the St. Joseph company.

SPRINGFIELD, MO.—The Springfield Gas & Electric Company may erect a new plant on a site yet to be purchased. It is stated plans are being drawn for a plant estimated to cost $250,000. A turbine of 5,000 kilowatts is planned on.

CHANUTE, KANS.—The Kansas Gas & Electric Company, W. F. Murrow manager, has completed arrangements for the construction of a $1,000,000 electric-power plant on the Santa Fe River. The plant will have a capacity of 10,000 kilowatt hours. The plant will be used as a feeder for many of the company's other properties in this section, and the smaller plants will be used as auxiliaries. It is expected that at least a year will be required for completion.

CONCORDIA, KANS.—An electric-light plant franchise has been asked for by the Concordia Electric Light & Power Company. L. K. Green is the president of the company.

DODGE CITY, KANS.—The Midland Electric Company is figuring on a line to Mullinsville.

HERINGTON, KANS.—A white-way lighting system may be installed in this city.

HUTCHINSON, KANS.—On recommendation of W. A. Knorr, the city has decided to install new lights at various places on its street-lighting system.

McPHERSON, KANS.—City officials are consulting with Black and Veach, engineers of Kansas City, on electric-light plant management and plans for additions.

MEADE, KANS.—The Meade Light & Power Company are now installing one 50-kilowatt, two 300-volt generator which is connected with the Fairbanks Morse oil engine. Early in the spring the company intends to install one three-ton Fisher ice machine. R. S. Gerow is general manager.

QUINTER, KANS.—An election will be held to vote on $14,000 in bonds for an electric-light plant.

SEDGWICK, KANS.—The council and mayor are authorized to get figures on installation and the maintenance of a white-way for Commercial Avenue.

WICHITA, KANS.—It has been proposed to illuminate South Water Street from Douglas to English Streets.

TOPEKA, KANS.—The town has adopted a platform for the coming city campaign, favoring the erection of the city electric-light plant at the water works station.

WICHITA, KANS.—The Kansas Gas & Electric Company has placed orders and contemplates the construction of about 50 miles of 66,000-volt line, 50 miles of 22,000-volt line and adding 15,000 kilowatts. H. S. Sladen, Wichita, Kans., is manager.

SOUTH CENTRAL STATES.

SOMERSET, KY.—The city council has approved a contract with the Kentucky Utilities Company for changing the street-lighting system of the city from the present arc plan to type C Mazda lamps, of which 150 will be erected to replace the 74 arcs and the 18 incandescents now in use. The city will pay all the cost of the change, over $500.

WALTON, KY.—Fire on Feb. 19 destroyed the electric-lighting plant at this city, at a loss of $5,000. J. E. Kelly is owner of the property. A meeting of citizens was held and the sum of $2,000 was subscribed to assist in re-establishment of the plant, which will be begun at once.

ALAMO, TENN.—Marion Darden has been granted a franchise for the construction of a lighting plant in this city.

HARTSVILLE, TENN.—The Hartsville Light & Ice Company has been organized by C. M. Gwing and others with a capitalization of $10,000 to construct and operate a lighting and refrigerating plant.

NASHVILLE, TENN.—Hilary E. Howse, former mayor of Nashville, advocates the enlargement of the municipal light plant so as to enable the city to furnish enough current.

CRYSTAL SPRINGS, MISS.—A. B. Kress, representing the Mississippi Power & Light Company, Jackson, Miss., was in this city to discuss the taking over of the municipal water and light plant and furnishing the town light from the company's plant in Jackson, a distance of 25 miles.

BENTONVILLE, ARK. — Linebarger Brothers Realty Company, of Dallas, Texas, have purchased a site for a summer resort and will construct a hydroelectric plant and water works system.

DUMAS, ARK.—The city has awarded a contract for the construction of a municipal lighting plant.

EL DORADO, ARK.—The Citizens' Light & Power Company will construct a plant for furnishing current to the citizens.

FORT SMITH, ARK.—The Coal District Power Company plans to furnish current to cities and mines located in Sebastian county. The company has been incorporated with a capitalization of $12,000 with Hugh Means, Lawrence, Kans., as president.

FORT SMITH, ARK.—Plans have been announced by the Fort Smith Light & Traction Company for the extension of its transmission lines.

MARSHALL, ARK. — Thomas Matlock will construct an electric-lighting plant in this city.

PINE BLUFF, ARK.—The Pine Bluff Corporation has been taken over by J. H. Watkins, of Memphis, Tenn., who will improve the system.

SPRINGDALE, ARK.—E. Masoner has been given a franchise for the construction of a lighting plant and waterworks in this city.

YELLEVILLE, ARK.—Isaac Emery has bought the municipal ice and light plant. He will install an oil burning engine for the light plant and mills and will extend the electric service.

COLFAX, LA.—This town contemplates a municipal light plant and waterworks, and is now negotiating with the Colfax Light & Power Company for the purchase of its plant. If the town and company come to an agreement its capacity will be doubled.

CLINTON, OKLA.—Francis Walker has taken the contract for putting in a muncipal plant at Strong City, Okla.

HASKELL, OKLA.—Plans are in progress for the installation of an electric-light plant, including two 120-horsepower engines, and two 75-kilowatt generators. A. H. Jones is engineer.

SKIATOOK, OKLA.—Election will be held March 20 to vote bonds in the sum of $20,000 for water works and electric-lighting plant. W. M. Calvin, is clerk.

AUSTIN, TEX.—The municipal water, light and power plant of this city will have its capacity increased in the near future by the addition of a 2,000-kilowatt unit. Extensions are also made to the ornamental lighting system in the city. E. C. Bartholomew is superintendent.

HEREFORD, TEX.—The town is to be given 24-hour service by the Hereford Light & Power Company and to take care of the increasing demand for electricity in this town it is officially stated that the lines are being extended considerable and will be further extended in the future.

WACO, TEX.—A street-lighting system for this city is being considered. The plan calls for the lights to be placed at intervals of 50 feet, in a base of concrete with steel binding about three feet in diameter, this base to be about 10 inches in height. Mr. Copley is city electrician.

WESTERN STATES.

BUTTE, MONT.—Within a few months 10,000 kilowatts will be added to the capacity of the Rainbow plant of the Montana Power Company of which F. M. Kerr is general manager. Installations will be completed at the Holter development by fall. These additions to the power supply of the districts will most likely call for additional electrical work to be done by the future consumer.

HELENA, MONT.—Directors of the Helena Light & Railway Company will build a power line to the Scratch gravel district to supply power to several mines. Improvements to be made will total about $80,000.

LIVINGSTON, MONT.—The city council is now negotiating with the Montana Power Company as regards a renewal of its contract for supplying electricity. The city is also considering improvements in its street-lighting system.

OSWEGO, MONT.—A resolution has been adopted which grants to Oswego the right to issue bonds for the purpose of building an electric-light and power plant. It is estimated that the cost of constructing and installing the plant will be $8,500. This will be covered by special assessment against the property embraced in the town.

SANTA FE, N. MEX.—The New Mexico Legislature has passed a bill validating the bonds issued by the town of Alamogordo, N. M., for purchasing the electric-light and power company.

MIAMI, ARIZ.—J. J. Mackay has applied for an electric-light, power and water franchise in East Miami Township.

PARKER, ARIZ.—Charles H. Hosfeld has petitioned the board of supervisors for a franchise to build an electric-light plant and operate and maintain an electric-lighting system.

YUMA, ARIZ.—The Yuma Light, Gas & Water Company has applied for franchise for the purpose of building an electric pole line from the city limits south along Orange Avenue to the county road, then west to the east bank of the East Main Canal, to supply power for the operation of a pumping plant.

YUMA, ARIZ.—E. F. Sanguinetti and F. L. Ewing have filed petition for a franchise to erect poles and wires for the transmission of electricity along the public highways of Yuma county.

WINNEMUCCA, NEV.—L. R. Eccles, Ogden, Utah, has taken over the Rye Patch mine near this city and it is stated that electric power will be used in the proposed new mill and also for running the air compressor. This necessitates the construction of about eight miles of transmision line.

INDEX, WASH.—The city has voted $20,000 in bonds for the construction of a light and water system.

SEATTLE, WASH.—The city's lighting department, J. D. Ross, superintendent, states that they are contemplating an addition to the city's municipal system of a hydroelectric plant of 22,000-kilowatt capacity. Plans have been made for enlarging the existing steam plant on Eastlake Avenue. This plant will have a rating of 9,375-kilovolt amperes and it is probable that additional work will be undertaken in connection with this augmented power.

SEATTLE, WASH.—The municipal lighting plant is preparing to serve the new Ames shipyard. The shipyard will require the use of 2,000 horsepower. The shipyard of the Skinner-Eddy Corporation has already connected with the city plant and is using 1,500 horsepower.

SEATTLE, WASH.—Financing the proposed 210 miles of Milwaukee electrification between Seattle and Othello has been arranged. Refunding bonds to the amount of $25,000,000 at 4.5 per cent have been issued.

TACOMA, WASH. — Wheeler - Osgood company will soon begin the construction of a power plant on the tide flats to cost $30,000 to $40,000. Eighteen hundred horsepower will be generated.

OSWEGO, ORE.—The county commissioners have adopted a resolution authorizing this city to issue bonds for a power and light plant to cost $8,500.

PORTLAND, ORE.—The Portland Railway, Light & Power Company, E. D. Searing, construction engineer, contemplates the reconstruction of the present 20,000-volt transmission line and this will be brought up to 57,000 volts. The line extends for 20 miles between Mount Angel and Salem, Ore. An addition will be made to the substation at Salem and 3,000-kilovolt-amperes in transformers will be installed. A 57,000-volt transmission line will be constructed between Beaver Creek and Oregon City and at the latter city the company will install a 1,250-kilovolt-ampere, 3-phase, 57,000 to 11,000-volt transformers. At the Columbia substation, Portland, a 400-kilowatt motor generator will be installed. At the River Mill station a 57,000-volt bus will be installed for testing high tension lines. Besides this several transformers will be installed at the company's various substations.

BAKERSFIELD, CAL.—Plans are being prepared for the installation of the new electrolier lighting system along Chestnut Avenue.

BRAWLEY, CAL.—Citizens have donated $450 for the purpose of increasing the street lights and paying for their maintenance during the year.

SANTA MONICA, CAL.—Santa Monica has completed plans for much city improvement during the year. A new lighting system will be installed.

CHICO, CAL.—Citizens have petitioned the supervisors to call an election for the purpose of forming a lighting district in Chapmantown.

EL CENTRO, CAL.—A. E. Sanguinetti of Yuma, Ariz., has received the contract to construct the new 55,000-volt transmission line between the Holton Power Company's plant at Holtville to Hanlon Heading. In connection with the power line telegraph and telephone lines will be run.

GRASS VALLEY, CAL.—The Pacific Gas & Electric Company has been granted the right of way through the Prisk tract for the erecting of poles and wires.

HANFORD, CAL.—The Mount Whitney Power & Electric Company has been granted a 50-year franchise by the supervisors of King County.

LOS ANGELES, CAL.—A meeting of the stockholders of the San Joaquin Light & Power Company will be held April 20 at the offices of the corporation for the purpose of deciding whether or not additional bonded indebtedness in the sum of $4,500,000 shall be created by the corporation to provide money for new construction.

LOS ANGELES, CAL.—The board of supervisors have granted permission for the furnishing of necessary equipment for the Graham Lighting district.

OAKDALE, CAL.—A new plant will be erected at Oakdale by the Sierra & San Francisco Power Company to provide light and power for the plants of the Valley Ice Cream Company and the Borden Condensed Milk Company, both of Modesto. The new improvements will cost $10,000.

RIVERSIDE, CAL.—The Southern Sierras Power Company, R. G. Manifold, engineer, intends to construct a line from El Centro, Cal., to Yuma, Ariz., and also a line from Victorville to Barstow, Cal. A new and larger pipe line will be built from Bishop Creek and at the Rush Creek plant an additional 5,000-kilowatt unit, consisting of a Pelton water wheel connected to an Allis-Chalmers generator, will be installed. This plant is now working under an 1,800-foot hydraulic head.

SAN DIEGO, CAL.—Lines are now being completed by the San Diego Consolidated Gas & Electric Company, from Oceanside to Fallbrook and from Vista to Escondido, the company is contemplating the construction of a 66,000-volt transmission line from Oceanside to San Juan Capistrano, a distance of 30 miles, besides the erection of a 11,000-volt line, 16 miles long, from Cardiff to Escondido.

WALKER, CAL.—The state water commission has granted permission to the Walker Mining Company of Salt Lake City, Utah, to appropriate 20 cubic feet of water from Ward and Nye Creeks in Plumas County for power purposes. The company's plans call for an expenditure of $25,000.

Foreign Trade Opportunities

[Addresses may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its offices at Boston, New York, Atlanta, Chicago, St. Louis, New Orleans, Seattle and San Francisco. Write on separate sheet for each item and give file number.]

CATALOGS.—The American Chamber of Commerce at Paris, with offices at No. 3 Rue Scribe, is establishing a catalog file and desires to receive catalogs from American manufacturers anxious to start or

increase business abroad. The chamber makes a proviso, however, that such catalogs as may be sent for its files should not exceed nine by 12 inches in measurement, as larger publications would not be suitable for its filing system.

NO. 23,810. LAMP REFLECTORS.—A man in Italy desires to be placed in communication with American manufacturers and exporters of reflectors for electric lamps, electric apparatus, and glassware of all kinds, 110 to 120-voltage bulb and globe lamps, and one-half watt lamps.

NO. 23,808. MOTORS AND CABLE.—An engineer of the Canary Islands is desirous of receiving prices, catalogs, etc., from American manufacturers and exporters of engineering supplies, such as multiple and spiral cables; carriers and tractors; cars, with a net capacity of 110 to 440 pounds; all kinds of motors; centrifugal and piston pumps; boilers and steam generators for distilling turpentine and distilling and refining rosin; equipment for preserving fruit and mechanical saws for timber.

Proposals

LIGHTING STANDARDS.—Bids are being received by the city clerk of Sarotelle, Cal., for the installation of 342 ornamental lighting standards for the city of Beverly Hills.

ORNAMENTAL LIGHTS.—The Elkhorn, Wis., light and water commission have advertised for proposals for furnishing the supplies and equipment for installing 57 ornamental street lights.

HYDROELECTRIC PLANT EQUIPMENT.—Proposals for miscellaneous auxiliary electrical equipment for extension to the Gatun hydroelectric station and Gatun substation, including switches, cable, conduit fittings, copper lugs, copper bar and rod; current transformers, disconnecting switches, insulators, transformers, etc. Bids will be received at the office of the General Purchasing Officer, Washington, D. C., March 10. Address Earl I. Brown, major, corps of engineers, U. S. A., General Purchasing Agent.

LIGHT FIXTURES.—The committee on lights, Aurora, Ill., has been directed to advertise for bids to furnish 100 street series incandescent light fixtures.

LIGHTING SYSTEM.—Sealed proposals will be received at room 614 City Hall, Chicago, March 8, for furnishing labor and material necessary for the construction of an electric lighting system to be installed during the years 1917 and 1918, consisting of approximately 25,000 100-candlepower type C Mazda residence units and 5,000 600-candlepower type C Mazda lamps, which will include: Feeder and transmission cable system; fiber duct and lead-covered cable-circuit system, lamp posts, transformers, etc.; armored-cable circuit system, lamp posts, transformers, etc. Address Wm. Keith, Commissioner of Gas and Electricity.

New Publication

INVESTIGATION OF CARTRIDGE INCLOSED FUSES.—The Bureau of Standards, Washington, D. C., has issued Technologic Paper No. 74, which is a report of the proceedings, tests and findings in the case of the Economy Fuse & Manufacturing Company vs. Underwriters' Laboratories, Incorporated, concerning the fire and accident hazard of the Economy refillable fuse, as compared with approved fuses. The report covers 19 large pages, and has a number of supplementary tables and oscillograh records. The Bureau's investigation shows that the Economy fuse, when new and properly filled or refilled, operates satisfactorily under the most common working conditions of overload and moderate short-circuits when in circuits with low inductance, and possesses some marked advantages over the approved fuses with which it has been compared. The Bureau's finding recommends that Economy fuses be not approved at present for general use on the same basis as fuses at present listed as standard by Underwriters' Laboratories, Incorporated, but that their use be permitted by municipal and underwriters' inspection departments under conditions where their performance can be observed by each inspection department until sufficient experience regarding their performance under service conditions can be obtained to justify an unqualified approval or refusal to approve.

Financial Notes

The stockholders of the Westinghouse Electric Manufacturing Company at a special meeting yesterday consented to the enlargement of the capital stock from $60,000,000 to $75,000,000, the additional stock consisting of 300,000 shares of a par value of $50.

The statements of the United Light & Railways Company, Grand Rapids, Mich., and its subsidiary companies show marked gains for December. The gross earnings of the subsidiary companies for December, 1916, totaled $673,703.40, as against $619,-854.74 in 1915, an increase of 8.7 per cent. The net earnings were $287,847.33, or an increase of 6.2 per cent, while the net profits over all expenditures were $169,-216.05, or an increase of 8.6 per cent. The company shows total gross earnings in December of $166,444.45, as against $153,-436.82 in December, 1915, or an increase of 8.5 percent. The net earnings totaled $143,-757.13, or a gain of 12.7 per cent, while the surplus earnings were $93,716.13, a gain of 19.2 per cent. The total gross earnings of the subsidiary companies for the entire year of 1916 were $6,885,386.33, or a gain of 9.1 per cent of 1915. The net earnings totaled $2,666,393.18, or a gain of 9.1 per cent. The net profits for the year show a gain of 16.6 per cent. The total gross earnings of the United Company for 1916 amounted to $1,257,490.42, or an increase of 16.5 per cent, while the net earnings totaled $1,193,272.82, a gain of 21.9 per cent. Surplus earnings gained 41.8 per cent.

The Public Utilities Company, Evansville, Ind., filed a petition with the public service commission to issue $3,951,000 in 3-year, gold, 5 per cent bonds, and $121,400 in preferred capital stock bonds. The bond issues are to be used to retire outstanding indebtedness.

Adirondack Electric Power Corporation reports for 1916 gross earnings of $1,512,-516, as compared with $1,317,068; net earnings $565,151, as compared with $550,792, and balance for dividends $306,864, as compared with $296,825. After 6 per cent on the preferred the balance was equivalent to 1.65 per cent on the common stock.

Kansas Gas & Electric Company, Wichita, Kan., reports January gross $189,874, increase $16,106; net $57,776, decrease $9,858; income after charges, $38,045, decrease $11,881; twelve months gross ended January 31, $1,613,988, increase $246,452; net $588,927, increase $60,007; income $368,-892, increase $35,211; balance $235,892, increase $24,711.

The capital stock of the Central Illinois Light Company has been increased from $7,500,000 to $20,000,000.

The Cities Service Company, New York, N. Y., gives the following financial report for the year ended January 31, 1917:

	Year ending Jan. 31, 1917.	Year ending Jan. 31, 1916.
Gross earnings	$11,301,249.06	$4,717,443.55
Expenses	242,903.94	178,143.02
Net earnings	$11,058,345.12	$4,539,300.53
Int. on notes and debentures	216,291.10	492,132.50
Net to stock	$10,842,054.02	$4,047,168.03
Divs. pref'd stk.	2,528,220.57	1,606,712.85
Net to com. stk.	$ 8,313,833.45	$2,440,455.18
Divs. com. stock	739,535.72	.....
Net to surplus and reserves	$ 7,574,297.73	$2,440,455.18
Number of times preferred dividend was earn.	4.29%	2.25%
Per cent earned on av amt. of com. stock outstanding	41.41%	16.26%
Preferred stock outstanding		$57,772,776
Common stock outstanding		30,342,347
In hands of public		22,570,457
In treasury of company		7,771,890

At the annual meeting of the Fall River Electric Light Company, Fall River, Mass., the financial statement was as follows: Assets—Plant and property, $2,430,599.33; cash and accounts receivable, $150,427.38; supplies, $799,984.74; total, $2,670,011.95. Liabilities—Capital Stock, $1,400,000; premium on new capital, $445,000; notes and accounts payable, $539,831.68; reserve, $189,-817.86; total, $2,574,619.54. Balance, profit and loss, $95,362.41; gross earnings, $517,-152.23; expenses, $379,425.87; net earnings, $137,726.36; interest on payments, $15,014.04; dividends declared, $112,000; direct-current motor changeover, $4,676.87.

The report of the municipal electric lighting plant at Logansport, Ind., for January shows $14,543.82 receipts, the largest ever collected in the history of the department. The expenditures for the month were $8,464.18. The total amount of cash on hand February 1 was $60,214.27, which, with $61,000 transferred makes $121,214.27.

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. Rate Per Cent	Bid Feb. 19	Bid Feb. 26
Adirondack Electric Power of Glens Falls, common	----	23	23
Adirondack Electric Power of Glens Falls, preferred	6	82	82
American Gas & Electric of New York, common	10+extra	140	136
American Gas & Electric of New York, preferred	6	51	51
American Light & Traction of New York, common	----	356	357
American Light & Traction of New York, preferred	6	112	112
American Power & Light of New York, common	4	86	83
American Power & Light of New York, preferred	6	91	91
American Public Utilities of Grand Rapids, common	----	38	35
American Public Utilities of Grand Rapids, preferred	6	69	90
American Telephone & Telegraph of New York	----	125½	124⅞
American Water Works & Elec. of New York, common	----	10½	11¼
American Water Works & Elec. of New York, particip	7	24	24
American Water Works & Elec. of New York, first preferred	----	67	69
Appalachian Power of Bluefield, common	----	7	6
Appalachian Power of Bluefield, preferred	7	37	37
Cities Service of New York common	6+extra	274	287
Cities Service of New York, preferred	6	89¼	90
Commonwealth Edison of Chicago	8	135	135
Comm. Power, Railway & Light of Jackson, common	4	58	57
Comm. Power, Railway & Light of Jackson, preferred	6	80	80
Federal Light & Traction of New York, common	----	14	12
Federal Light & Traction of New York, preferred	----	51	51
Illinois Northern Utilities of Dixon	6	82	82
Middle West Utilities of Chicago, common	2+2 extra	58½	58½
Middle West Utilities of Chicago, preferred	6	*78½	78½
Northern States Power of Chicago, common	7	101	100
Northern States Power of Chicago, preferred	7	98½	98½
Pacific Gas & Electric of San Francisco, common	5	64¼	64
Pacific Gas & Electric of San Francisco, preferred	6	92½	93
Public Service of Northern Illinois, Chicago, common	7	107	105
Public Service of Northern Illinois, Chicago, preferred	6	99½	98½
Republic Railway & Light of Youngstown, common	4	47	44½
Republic Railway & Light of Youngstown, preferred	6	76	73½
Standard Gas & Electric of Chicago, common	----	12	11
Standard Gas & Electric of Chicago, preferred	6	38	39
Tennessee Railway, Light & Power of Chattanooga, common	----	8	8
Tennessee Railway, Light & Power of Chattanooga, preferred	6	37	38
United Light & Railways of Grand Rapids, common	4	47	46½
United Light & Railways of Grand Rapids, preferred	6	76¾	76½
Western Power of San Francisco, common	----	16	17½
Western Power of San Francisco, preferred	6	65	65
Western Union Telegraph of New York	5+extra	94	93¾
Industrials—			
Electric Storage Battery of Philadelphia, common	4	62	63
General Electric of Schenectady	8	165	161½
National Carbon of Cleveland, common	8	†300	†300
National Carbon of Cleveland, preferred	7	†130¼	†130¼
Westinghouse Electric & Mfg. of Pittsburgh, common	5+extra	50⅝	49
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	69	69

† Last Sale.
* Extra Dividend.

Incorporations

KOSSE, TEX.—Kosse Light & Power Company. Capital, $12,000. Incorporators: L. T. Gibbs and W. D. Allen.

RIPLEY, TENN.—Lauderdale Light & Power Company. Capital, $20,000. Incorporators: W. W. Craig and others.

CANTON, O.—King Electric Company. Capital, $30,000. Incorporators: F. J. Wilson, E. M. Lower, G. B. Kellogg, Wendell Herbruck, K. E. Chader.

SEATTLE, WASH.—Standard Electrical Company. Capital, $15,000. Incorporators: Geore F. Crum, D. J. Conners and J. W. Logan.

TULSA, OKLA.—Tulsa Electric Shop. Capital $10,000. Incorporators: David Evans, G. E. Williamson, R. L. Imler, all of Tulsa.

SEATTLE, WASH.—Standard Electrical Company. Capital, $15,000. Incorporators: George F. Crum, J. W. Logan and D. J. Conners.

COUNCIL BLUFFS, IOWA.—Damon Electric Company. Capital, $5,000. Incorporators: E. S. Damon, Frank W. Officer and John J. Whack.

NEW YORK.—Expert Display Corporation. Electrical work, etc. Capital, $5,000. Incorporators: Leopold Friedman, Henry G. Wiley and Harry Harris, all of 32 Nassau Street, New York City.

NEW YORK.—B. F. Wood Engineers, Incorporated. Electrical business. Capital, $1,000. Incorporators: B. F. Wood, Walter E. F. Bradley and Alonzo B. Bradley, all of 233 Broadway, New York City.

BATAVIA, O.—Batavia Light & Power Company. Capital, $10,000. Incorporators: Allen B. Nichols, E. H. Speidel, Percy F. Jamieson, M. J. Kain and H. F. Duerkie.

FORT SMITH, ARK.—Coal District Power Company. Capital, $120,000. Incorporators: L. A. Petit, Jr., L. E. Turner, G. W. Skow, Hugh Means and Albert Emanuel.

RENO, NEV.—Western Gas & Power Company. Capital, $1,000,000. Incorporators: C. S. S. Forney, B. F. Silverstein, C. J. Parks, A. L. Erb and Lon Claybaugh, of San Francisco, Cal.

FRIENDSHIP, N. Y.—Friendship Lighting Corporation. Electricity for light, heat, power. Capital, $50,000. Incorporators: M. A. White, J. P. Hopson, G. Wishart, 101 Park Avenue, Manhattan, N. Y.

NEW YORK CITY.—The Freiman Rudges Company. Electrical novelties. Capital, $5,000. Incorporators: Meyer J. Freiman and May Freiman, and Jacob Rudges, all of Bronx, N. Y.

BROOKLYN, N. Y.—Standard Lamp & Shade Company. Gas and electric fixtures. Capital, $5,000. Incorporators: Louis Brook, Barnet Popkin and S. A. Telsey, all of Brooklyn, N. Y.

NEW YORK, N. Y.—Town Light & Power Company. Capital, $100,000. To engage in electric lighting and power business. M. R. Lawrence, Brooklyn, N. Y.; P. V. Lawrence, Brooklyn, N. Y., and T. J. Whalen, New York, N. Y.

BUFFALO, N. Y.—Stinson & Gould, Incorporated. Capital, $10,000. Storage batteries, electrical machinery, etc. Incorporators: R. H. Templeton, C. F. Gould and J. E. Stinson, Buffalo, N. Y.

BUFFALO, N. Y.—Ampere Lock & Switch Corporation. Capital, $10,000. To manufacture electrical machinery and appliances, locks and switches. Incorporators: W. H. H. Davenport, A. L. Higley and W. H. Farnsworth, 937 Main Street.

NEW YORK CITY.—Greeley Electric Company. Electrical business. Capital, $5,000. Incorporators: W. John Killoch, Brooklyn, N. Y.; E. E. Higbie, New York City, and Chas. W. Hagen, Brooklyn, N. Y.

NEW YORK, N. Y.—Whiteside Manufacturing Company. Capital, $30,000. To manufacture electrical and scientific apparatus and materials. Incorporators: A. J. Sommer, O. Sampter and J. A. Anger, Jr., New York, N. Y.

NEW YORK, N. Y.—Electrical Testing Laboratory of New York, Incorporated. Capital, $10,000. To engage in electrical testing and contracting. Incorporators: T. P. Gorman, W. Townley, Jr., and J. F. Burns, Jr., Astoria, L. I.

BROOKLYN, N. Y.—Perfect Electric Battery Company. Capital, $10,000. Incorporators: Harry Ratener, 490 Warwick Street, Brooklyn, N. Y., Jos. Levy, 349 Lott Avenue, Brooklyn, N. Y., and Samuel Fischer, 102 Norfolk Street, New York City.

Electrical Patents Issued February 20, 1917

Prepared by Thomas Howe, Patent Attorney, 2 Rector Street, New York, N. Y.

1,216,265 and 1,216,266. Insulating Composition. L. H. Baekeland, assignor to General Bakelite Co., New York, N. Y. First patent: Initial phenolic condensation product rendered infusible by heat and a solvent containing neutral oil. Second patent: Reaction product of phenols and anhydro-formaldehyde-anilin and a chlorinated-hydrocarbon solvent.

1,216,272. Recorder. C. W. Berry, W. Somerville, Mass. Electrical temperature indicator.

1,216,294. Combined Car Train Pipe and Electric Coupling. J. S. Doyle and F. Hedley, assignors to Westinghouse Air Brake Co., Pittsburgh, Pa. Structural details.

1,216,300. Car-Door Control. T. Farmer, assignor to Consolidated Car Heating Co., W. Va. Electrically controlled pneumatic motor.

1,216,305. Automatic Telephone System. C. L. Goodrum, assignor to Western Electric Co., New York, N. Y. Comprises a connecting circuit in sections connected by a repeating coil.

1,216,313. Electric Heater. L. Heller, Teplite, Austria-Hungary. Cooking utensil.

1,216,319. Reel for Electric Conductors. H. R. Huling, Schuykill Haven, Pa. For extension lamp.

1,216,323. Telephone Subscriber's Calling Mechanism. A. E. Keith, assignor to Automatic Electric Co., Hinsdale, Ill. For automatic system.

1,216,331. Changeable Vault Structure for Electric Furnaces. B. C. Kvaerno, Haugesund, Norway. Details of construction.

1,216,337. Electric Conductor. A. H. McCulloch and C. D. McCulloch, Boston, Mass. Structure of spirally wound covering.

1,216,357. Telephone Pay Station. C. E. Pratt, Chicago, Ill. Has clock controlled contacts.

1,216,365. Automatic Telephone System. C. E. Rogers, assignor to Automatic Electric Co., Chicago, Ill. Relates to connection of trunks having repeaters.

1,216,369. Railway Signaling. J. E. Saunders, assignor to Union Switch & Signal Co., Swissvale, Pa. Block system.

1,216,370. Telltale and Switch for Rear Signal Lights for Automobiles. W. P. Seng, Chicago, Ill. For mounting on steering post.

1,216,371. Process for the Manufacture of Hydroxide of Aluminum. B. Schwerin, assignor to Elektro Osmose Aktiengesellschaft, Frankfort-on-the-Main, Germany. From aluminate of the alkali.

1,216,372. Trolley Hanger. J. Scott, Cleveland, O. Structural details.

1,216,379. Vibrator for Induction Coils. H. C. Thomson, Canton, Mass., and H. N. Michaelsen, assignors to Samson Electric Co. Details of device for ignition apparatus.

1,216,386. Electric Switch. A. F. Williams and E. A. Halblieb, assignor to North East Electric Co., Rochester, N. Y. Rotary, snap.

1,216,397. Induction Motor. B. F. Bailey and J. M. Barr, O. S. More and L. G. Dong, assignors to Fairbanks Morse Electrical Mfg. Co., Indianapolis, Ind. Centrifugally controlled resistance on rotor for automatically controlling supply of current to motor.

1,216,404. Self-Igniting Electric Arc Candle. J. Billiter, Vienna, Austria-Hungary. Composition for forming the intermediate layer.

1,216,406. Electrical Receptacle for Conduit Outlet Boxes. C. H. Bissell, assignor to Crouse Hinds Co., Syracuse, N. Y. Structural details.

1,216,413. Current Converting Device. A. R. Bullock, Cleveland, O. Commutator device.

1,216,420. Relay. F. L. Dodgson, assignor to General Railway Signal Co., Gates, N. Y. Has special arrangement of contacts with shunt break of refractory material.

1,216,422. Portable Electric Lamp. W. P. Dunham, Los Angeles, Cal. Includes a supporting suction cup and a conductor winding barrel.

1,216,429. Refillable Indicating Fuse. G. W. Fiske, Akron, O. Enclosed fuse having one terminal sliding and a projection extending to the outside of the casing.

1,216,435. Traffic Indicator for Automobiles. J. M. Gillies and A. Moynihan, Salem, N. Y. Electrically lighted.

1,216,446. Electromagnetic Apparatus. C. O. Harrington, assignor to Union Switch & Signal Co., Swissvale, Pa. Special structure of relay with shunt breaking contacts.

1,216,450. Electric Battery. M. E. Holmes, assignor to National Carbon Co., Cleveland, O. Has a depolarizer consisting of a specially treated manganese peroxid.

1,216,451. Battery Depolarizer. M. E. Holmes, assignor to National Carbon Co. Consists of a neutral manganite.

1,216,461. Telephone Ring Back or Reverting Call System. G. E. Kimball, assignor to Automatic Electric Co., Chicago, Ill. Arrangement of differently timed slow-acting relays controlling a trunk-release circuit in an automatic system.

1,216,480. Telephone. K. Nichols, Cincinnati, O. Has two receivers and a transmitter supported by a single fitting.

1,216,513. Knife-Blade Switch. A. K. Sutherland, assignor to Trumbull Electric Mfg. Co., Plainville, Conn. Has a spring keeper for preventing the blade from falling closed.

1,216,518. Electrical Regulators. A. A. Tirrill, assignor to Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa. Vibratory contact field regulator for dynamos.

1,216,533. Electrical Telegraph and Indicator System. F. W. Wood, assignor to Charles Cory & Son, Inc., New York, N. Y. Combined electrical order transmitting and receiving instrument.

1,216,534. Automatic Telephone System. G. A. Yanochowski and H. E. Hershey, assignors to Automatic Electric Co., Chicago, Ill. Comprises means for signaling an operator if a selector strikes an open trunk.

1,216,538. Means for Producing Electrical Oscillations. C. C. Arco and R. H. Rendahl, assignor to Gesellschaft Fur Drahtlose Telegraphie M. B. H., Berlin, Germany. For producing slightly damped oscillations by the shock excitation method.

1,216,545. Wire Connector. J. E. Burgess, assignor to United Railway Co., of St. Louis, Mo. For repairing broken trolley wires.

1,216,553. Push Button. H. C. Dolan, assignor of one-half to M. J. McLeod, Detroit, Mich. Coiled spring circuit closer.

1,216,559. Switch Lock for Motor Vehicles. G. Frank, assignor of one-half to M. J. Whelan, Jefferson, Tex. For preventing unauthorized operation of the switch.

1,216,570. Electromagnetic Time Retarding Relay. K. Hohn, Zurich, Switzerland, Structural details.

1,216,595. Transmission of Electrical Impulses Over Circuits of High Electrostatic Capacity. G. Musso, Vado, Italy. For telephone circuits.

1,216,599. Transmission Gearing-Control Mechanism. V. W. Parker, Laddonia, Mo. Electromagnetic control for use on automobiles.

1,216,604. Hoisting Mechanism. P. B. Phillips, Portland, Me. Electrically driven mechanism for operating a clam shell bucket.

1,216,605. Electric Heater. J. Porzel, Buffalo, N. Y. Structural details of radiator.

1,216,613. Thermo Electric Carbureter. C. F. Schulz, Brooklyn, N. Y. Air and oil are electrically heated prior to their introduction.

1,216,615. Apparatus for Producing Powerful Electrical Oscillations. G. Seibt, assignor to Atlantic Communication Co., New York, N. Y. Special arrangement comprising coupled primary and secondary oscillation circuits.

1,216,633. X-Ray Table. J. B. Wantz, assignor to Victor Electric Co., Chicago, Ill. For radiographic and fluoroscopic work.

1,216,634. Egg Tester. J. B. Warren, assignor to Broadfield Poultry Farm, Bolton,

Mass. Comprises a number of successively lighted lamps.

1,216,641. Automatic Telephone System. C. S. Winston, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Relates to a metallic line control circuit for automatic switches.

1,216,646. Method of Producing High Frequency Oscillatory Currents. J. C. Armor, Ingram, Pa. Non-oscillatory, uni-direction currents are produced in a primary circuit by subjecting its gap to a jet of insulating fluid, and oscillatory currents are induced in a secondary circuit.

1,216,647. Means for Producing High Frequency Oscillatory Currents. J. C. Armor, Brooklyn, N. Y. Relates to the arrangement of the gap in the above.

1,216,651. Electrical Make and Break Tripping Mechanism for Two or Four Cycle Gas Engines. M. H. Borland, Seekonk, Mass. Is interconnected with water circulating pump.

1,216,658. Electromagnetic Valve. L. C. Mars, assignor to Conservative Heating Co., San Francisco, Cal. Structure of solenoid operated device.

1,216,678. Bilge-Water Alarm. C. R. Ford, Paducah, Ky. Has a float controlled circuit.

1,216,720. Wireless Telegraph Transmitter of the Portable Type. M. A. Mulrony, Randwick, New South Wales, Australia. For short distance work.

1,216,724. Electric Hand Mirror. J. A. Petrie, New Haven, Conn. Has a battery lamp on the handle.

1,216,743. Electric Bell. W. J. Smith, assignor to Edwards & Co., New York, N. Y. Details of electromagnetic vibrator.

1,216,756. Dimmer for Electric Lamps. I. C. Williams and C. F. Williams, Indianapolis, Ind. Rheostat structure.

1,216,764. Lamp Bracket. C. A. Anderson, assignor to C. H. Foster, Chicago, Ill. Headlight support for automobiles.

1,216,776. Telephone Attachment. J. J. Convery, New York, N. Y. Receiver supporting and hook operating extension arm attachment.

1,216,792. Ignition System. V. A. Fynn, assignor to Wagner Electric Mfg. Co., St. Louis, Mo. Circuit arrangement for combustion engines.

1,216,793. Ignition Controlling Apparatus. V. A. Fynn, assignor to Wagner Electric Mfg. Co., St. Louis, Mo. Has speed control of timer and fuel.

1,216,801. Portable Extension Lamp Cord Adjuster. M. H. Harter, assignor to Handy Mfg. Co., Minneapolis, Minn. Has special arrangement of cord reels.

1,216,818. Lamp-Shade Holder. M. Kossmann, Brooklyn, N. Y. For attachment to socket.

1,216,819. Lighting Fixture. F. C. Krueger, Milwaukee, Wis. Special arrangement of reflectors, etc., in a standing lamp.

1,216,820. Electric Signal. T. P. Lancaster and J. L. Struthers, Lynn, Mass. Details of electromagnetically operated signals and lamps.

1,216,828. Automobile Horn. R. H. Manson, assignor to Garford Mfg. Co., Elyria, O. Has diaphragm operated by electromagnets.

1,216,829. Electric Musical Instrument. H. S. Martin, assignor to Choralcelo Co., Boston, Mass. Structure of device having electromagnetically vibrated disk.

1,216,843. Carbureter. E. C. Richard, Flint, Mich. Comprises an electric heater.

1,216,844. Electrical Controlling System. J. G. Roberts, assignor to Western Electric Co., New York, N. Y. Telephone exchange system with special reference to the control of the supervisory signal.

1,216,846. Interlocking Control System for Elevators. H. Browntree, Kenilworth, Ill. Has special arrangement of door, signal and hoisting motor circuits.

1,216,855. Eye Shield Diffuser. J. F. Scott, Indianapolis, Ind. A translucent bowl is suspended about end of incandescent lamp bulb.

1,216,862. Electric Pencil. A. E. Sickles, Coyle, Okla. A pencil tube is included in a flashlight.

1,216,867. Control of Current to Large Inductances. J. C. Smith, Louisville, Ky. Current is applied with inductance shunted and resistance in series; shunt is broken, then resistance short circuited. In cutting out operations are reversed.

1,216,883. Detachable Attachment Plug. G. B. Thomas, assignor to Bryant Electric Co., Bridgeport, Conn. Structural details.

1,216,884. Lamp Grip. G. B. Thomas, assignor to Bryant Electric Co. For preventing unscrewing of lamp from socket.

1,216,887. Inductive Wireless Telephone System for Railroads and the Like. T. G. Thornblad, K. H. Warfvinge and V. G. Werner, Stockholm, Sweden. The stationary circuit is formed by the telephone or telegraph wires along the track.

1,216,888. Electrical Regulator. A. A. Tirrill, assignor to Westinghouse Electric & Mfg. Co. Structural details of electromagnetically operated contacts of a vibratory contact regulator.

1,216,901. Trolley Head. A. L. Williams, Los Angeles, Cal. Structure of special device.

1,216,910 and 1,216,911. Projection Apparatus. A. Ames, Jr., Tewksbury, Mass. Reflector arrangements.

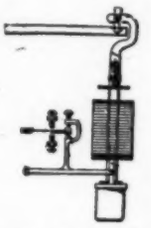
1,216,912 and 1,216,913. Reflector. A. Ames, Jr. Special structures.

1,216,914. Projection Apparatus. A. Ames, Jr. Reflector arrangement.

1,216,946. Acoustic Multiplier. E. E. Clement, Washington, D. C. For telephone transmitters.

1,216,947. Method of Electric Arc Welding Heating and Metal Working and Apparatus Therefor. C. L. Coffin, assignor to Electric Metal Working Co., Detroit, Mich. Work is heated by an adjacent arc in a magnetic field.

1,216,953. Magnetic Compass. F. O. C. Osborne, Horsell, Woking, and A. J. Hughes, London, England. Arrangement of magnets.



1,216,888. Electrical Regulator.

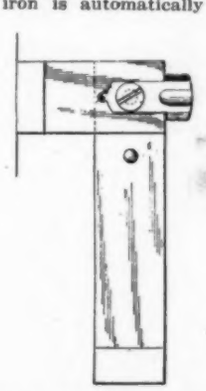
1,216,960. System of Suspension for Tramway and Railway Cars. C. Delmez, Antwerp, Belgium. Details of motor supports.

1,216,961. Electric Furnace. H. DeMolly, assignor to Societe Electri Metallurgigue, De St. Beron, Lyons, France. Detailed structure for fusing metals by passing current through them.

1,216,979. Combined Flashlight and Toilet Article. A. Freed, Highwood, Mont. Comprises a mirror.

1,216,982. Railway Signal. A. E. Gauthier, Bay City, Mich. Relates to disconnectible connections between cars of a train for completing circuit of a signal carried by the locomotive.

1,217,000. Stationary Electric Iron Heater. A. S. Iserson, New York, N. Y. Resistor of iron is automatically connected



1,216,513. Knife-Blade Switch.

in circuit when iron is placed on the support and disconnected on removal.

1,217,026. Testing Apparatus for Flashlights. G. A. Ley, Chicago, Ill. Has a flash powder holder and lamp compartment with an electric fuse for flashing the powder and a battery connected to the lamp and fuse.

1,217,032. Insulator for Electric Wires. C. Lyon, Emmett, Idaho. Tieless; for securing direct to cross arm.

1,217,053. Safety Mechanism for Power Operated Doors. H. F. Parish, assignor to Grinden Art Metal Co., Brooklyn, N. Y. Is electrically prevented from being forced shut if it strikes an obstacle.

1,217,058. Electric Lamp Connector. E. A. Pohl, Georgetown, O. Arrangement of conductors and contacts in plug of insulation.

1,217,069. Safety and Signal Apparatus for Fire Alarm Boxes. M. Rugel, Milwaukee, Wis. Alarm box is in cage, the box door being opened when the cage door is closed and a signal arm and lamp are displayed.

1,217,080. Telephone Exchange Apparatus. F. W. Adsit, assignor to Adsit Electric Co., Minneapolis, Minn. Cord circuit comprises timing means which opens its connection with the line circuit after a predetermined time.

1,217,081. Telephone Lockout System. F. W. Adsit, Minneapolis, Minn. Adapted for connection with a common battery exchange.

1,217,114. Electric Switch. J. S. Jones, New York, N. Y. Rotary snap-switch.

1,217,121. Telephone Exchange System. A. S. Keith, assignor to Automatic Electric Co., Chicago, Ill. Automatic.

PATENTS EXPIRED.

The following United States electrical patents expired on February 27, 1917:

644,050. Manufacture of Lead Peroxide and Its Application to Electrical Storage Batteries. H. Beckmann, Witten, Germany.

644,051. Controller for Alternating-Current Circuits. E. J. Berg, Schenectady, N. Y.

644,072. Automatic Gravity Cut-Out for Electrical Circuits. W. Hanlon, Poughkeepsie, N. Y.

644,094. Electrical Bond for Railroad Rails. J. M. Price, Philadelphia, Pa.; W. F. Price and W. L. Price, executors of J. M. Price, deceased.

644,108. Contact Device for Conduit Electric Railways. C. F. P. Stendebach, Leipsic, Germany.

644,128. Automatic Controller for Electric Compressors. N. A. Christensen, Milwaukee, Wis.

644,143. Electric Gas-Lighting Candle Burner. R. N. Noyes, Haverhill, Mass.

644,144. Connecting Plate for Storage Batteries. H. G. Osborn, Chicago, Ill.

644,160. Electric Glow Lamp. W. Boehm, Berlin, Germany.

644,204. Switch Box for Intercommunicating Telephone Systems. A. K. Keller, Philadelphia, Pa.

644,205. Telephone Transmitter. A. K. Keller, Philadelphia, Pa.

644,206. Telephone Receiver. A. K. Keller, Philadelphia, Pa.

644,213. Motor Suspension. E. C. Nicewaner, Johnstown, Pa.

644,251. Electric-Contact Apparatus. C. G. O. H. von Konler, Stockholm, Sweden.

644,278. Means of Regulating Electric Machines. W. H. Cooley, Brockport, N. Y.

644,311. Method of Winding Helices for Electrical Purposes. J. C. Anderson, Jersey City, N. J.

644,312. Electrical Helix. J. C. Anderson, Jersey City, N. J.

644,315. Telephonic Relay. F. H. Brown, Oak Park, Ill.

644,340. Electrical Measuring Instrument. J. W. Packard, Warren, O.

644,357. Multiple-Fuse Cut-Out. J. B. Hubbard and C. J. Dorsey, Baltimore, Md.

644,370. Apparatus for Adjusting Elevation of Guns. G. A. Schoeller, Mulheim-on-the-Ruhr, Germany.

644,407. Automatic Regulation of Systems of Electrical Distribution. J. L. Creveling, New York, N. Y.

644,408. Car-Lighting System. J. L. Creveling, New York, N. Y.

644,409. Electrical Distribution. J. L. Creveling, New York, N. Y.

644,433. Signal Apparatus for Boilers. W. B. Lowe, Jr., Atlanta, Ga.

644,448. Circuit Closer for Telegraph Keys. E. E. Nye and L. C. McIntosh, Los Angeles, Cal.

644,497. Wireless Telegraphy. A. F. Collins, Saratoga Springs, N. Y.

644,510. Process of Electrical Reduction. E. F. Frost. Washington, D. C.

644,517. Resistance Switch for Electric Circuits. J. H. Holmes and F. Broadbent, Newcastle-upon-Tyne, England.

644,538. Voltaic Cell. A. Piannenberg, Berlin, Germany.

644,547. Telephone Transmitter. E. B. Fahnestock, Washington, D. C.

644,551. Electric Signaling Apparatus. G. Harris, Detroit, Mich.

644,552. Electric Meter. G. Hookham, Birmingham, England.

644,553. Apparatus for Converting Alternating into Continuous Current and Vice Versa. M. Hutin and M. Leblanc, Paris, France.

644,554. Electric Recuperator. M. Hutin and M. Leblanc, Paris, France.

644,555. Process of Reducing Apparent Inductance of Electrical Circuits. M. Hutin and M. Leblanc, Paris, France.

644,561. Microphone. E. B. Fahnestock, Washington, D. C.

Design.

32,297. Switchboard. H. O. Swoboda, New York, N. Y.